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ON FUTURE WARFARE

BY

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TO THE ARMOURED FORCE.

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PREFACE.

I can understand the Quaker spirit, the Crusader spirit, and the Mercenary spirit. I can understand a man detesting war, glorying in war, looking upon it as good business. But I cannot understand anyone wishing to repeat the last war. I doubt much whether such a man could be found, a man who, having experienced the squalor of the Somme and of Ypres, could honestly say: "I loved it." Frankly, the last war was a horrible affair, and had it not been for the heroism of the millions who took part in it, it would have been utterly bestial. A tragedy in itself, it has given birth to a greater tragedy—what have we learnt from it? If another war were to engulf the world to-morrow, it would be the Great War over again, with its trenches, and its wire, and its mud. As to this there can be no question, since the armies of to-day are still the armies of 1914; masses of men who cannot face fire, but who can deliver it in such overwhelming strength that the art of war expires in slaughter and in universal ruin. Yet all this can be changed by half an inch of steel.

This, then, is the central problem of my book—half an inch of steel to cancel out half an ounce of lead. It will not abolish war, but it will refine its grossness. It will once again make the offensive stronger than the defensive, it will reinstate war as an art, and exalt mind over body. It will reduce the size of armies; render wars, especially between the smaller powers, less frequent; will shorten the length of battles, and reduce cost, casualties and destruction. If wars are to continue, seeing what the last war has to teach us, surely it is wiser to fight behind armour than in woollen jackets.

I saw this quite clearly when I joined the Tank Corps in 1916, for the vision, if you will, stood out like a silhouette against the gloomy background of the battle of Beaumont Hamel, surely one of the most terrible ever fought. I saw in the tank a reincarnation of the *Merrimac* and the *Monitor*, and, knowing something of naval history, I also saw the ultimate end—mechanised warfare on land, just as these two old ironclads led to mechanised warfare at sea.

Shortly after the battle of Hampton Roads, in 1862, the London *Times* said: "Whereas we had available for immediate purposes one hundred and forty-nine first-class warships, we have now two, these two being the *Warrior* and her sister *Ironside*. There is not now a ship in the English navy, apart from these two, that it would not be madness to trust to an engagement with that little *Monitor*."

In 1918, battle after battle was won by the tank, and the Allied plan for 1919 was a campaign almost entirely founded on this machine. After the war every army went back to an infantry basis, yet curiously enough the Germans were forbidden to build tanks. In 1862, "England and all other maritime powers immediately proceeded to reconstruct their navies, and the old-fashioned three and four-decker line-of-battle ships were condemned as useless." In 1927, we still have an infantry army; yet, history is going to repeat itself; the end is certain; this is not the problem, which is: Shall we attain it in time to mitigate slaughter? Loss of money does not matter much, but unnecessary loss of life is horrible.

This then has been my object since 1916—to persuade the Army to do what the Navy has already done. For just on eleven years I have written and lectured on this subject, not that it has been a profitable task; but, I think, it has been a worthy one; and, still believing it to be so, I have collected together in this book seventeen lectures and articles out of five to six times that number, and have set them together so as to form a continuous narrative. I have not attempted to bring them up to date; unfortunately, in my opinion, none have as yet reached obsolesence. Here and there I have cut out such over-lappings as would be tedious to the reader, and have corrected such errors as I have discovered. I thank the Editors of the following Reviews and Journals for their courtesy in allowing me to publish these studies — *The Royal Engineers Journal*, *The Fighting Forces*, *The Journal of the Royal Artillery*, *The Nineteenth Century and After*, *The Army Quarterly*, and *The Journal of the United Service Institution of India*. Also I wish to thank Mr. A. J. Sifton for so kindly reading through the proofs.

That there is room for this book I believe, since military journals are seldom read by the public, but what persuaded me most of all that a book of this nature may help a worthy cause is a story told me a few weeks ago by a friend. It was as follows:

Junior Staff Officer: " Sir, a proposal has been made to mechanise the X Company YZ."

Senior Staff Officer: " What! another unit to be mechanised, why, soon we shall have no army at all."

Aldershot. J. F. C. F.

20th November, 1927.

CHAPTER I.

THE PRINCIPLES OF DEFENSIVE WARFARE.(1)

Before the outbreak of the last War, all armies were organised for mobile warfare, and many soldiers considered that the war would be rapid and short. To-day, for similar reasons, all armies are organising for a war of movement, and the greatest surprise of the last war, namely, its static nature, is not only being forgotten, but to mention its recurrence is to risk being classed as a heretic. In 1914, as M. Bloch had foreseen twenty years earlier, it was fire-power and human nature which were the parents of the trench. Since 1914, human nature has not changed, but whilst then an infantry division was equipped with 24 automatic weapons, to-day it possesses over 500. In 1914, the maximum (aimed) fire-power of a division in S.A.A., was about 55,000 rounds a minute, to-day it is 155,000. Thus far the conclusion is, that if a great war broke out to-morrow, unless armies possess large numbers of tanks, it will be a war of trenches, for, if they do not, it will take at least a year to produce them in any quantity.

1. *The Foundations of the Defensive.*

The following theory is based on the experiences of history; therefore to discard it is an act both dangerous and foolish:—

(i) The offensive should be assumed on all occasions when circumstances permit.

(ii) Offensive action should spring from a strong defensive base.

(iii) The defensive should be so organised as to permit of it changing into an offensive at the shortest possible notice.

(iv) The offensive cannot be too strong in reserves, therefore the defensive should not employ a weapon beyond the minimum necessary to establish security.

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(1) *Royal Engineers Journal,* June, 1925.

The following, drawn from the past, are errors worth remembering:—

(i) The offensive languishes on that side which is least prepared to wage war, and which is, through ignorance of the principles of war, blinded by the belief that the enemy must be held back at all points, and that, consequently, it is necessary to be everywhere equally strong in men, and superlatively strong in defences.

(ii) The unreality of peace teaching generally leads to the creation of "impregnable positions," in place of such preparations as will aid a rapid assumption of the offensive.

(iii) The all but total depletion of a reserve, that is, a striking force, on account of the stringing out of troops for purely defensive tactics, such as the passive holding of trenches, villages and fortified positions, renders a sustained offensive impossible.

(iv) The general demoralisation and disorganisation of all ranks by the incessant creation of new defences, and the repair of old ones, detrimentally affects training and leadership, and, consequently, lowers the offensive spirit of all concerned.

I will now briefly consider the principles of war in their defensive aspect. Bearing in mind that there is no hard and fast dividing line between the offensive and defensive in warfare, we find that the object is the same. Shielding does not consist solely in preserving our own existence, but in preserving it in order that we may the more economically destroy the enemy; consequently, a defensive battle should be based on an offensive plan, which through force of circumstances cannot at once be put into operation.

Superiority of weapons at the decisive point means superiority of offensive power, and the lack of this superiority is frequently the direct cause of defensive action. If men are squandered in attempts to avoid blows they will never be in a position to give them, and not giving them, they allow their enemy to reduce his defensive strength to a minimum, and to increase his striking force in proportion. It was against this type of warfare that Napoleon inveighed when he wrote to his brother, the King of Spain, saying: " The cordon system is only good against smugglers," yet, for over three years, the grand tactics of the Great War on the Western Front were based on this system.

Infringing the principle of concentration, the cordon system simultaneously infringes economy of force. The defensive becoming the main object, a time arrives when the offensive becomes inoperative, not through lack of weapons, but through the impossibility of massing them. Garrisons must be in proportion to the trenches they occupy, and if trenches are over large, garrisons cannot be relieved without seriously weakening them. Ten men will hold a blockhouse, and a blockhouse may delay a brigade; ten men will not hold a fortress; therefore, in our defensive plans, do not let us build fortresses when blockhouses suffice. The strength of defences does not rest in their size, but in harmony between their size and the strength of their garrisons.

Besides the danger of weakening established forces in order to build up a strong reserve, another danger presents itself, namely, excessive immobility due to over extension, which leads to an infringement of the principle of mobility.

Consequently, before we plan our defences, we should carefully consider the following maxims:

(i) When from a state of defence the offensive is assumed, this act should in no way disorganise the existing defensive arrangements.

(ii) Any delay in the assumption of the offensive from the defensive may prove fatal to both operations.

(iii) In offensive action, *moral* weakens in proportion as improvisation increases.

The first is a violation of the principle of security, the second of mobility, and the third of co-operation.

The principle of surprise finds an all but unlimited application in the defensive. I will take one small instance as an example—the siting of wire entanglements. In the Great War, the tactical effect of wire was immense, but the use made of it during the first two years of the war was beneath contempt. The true use of wire does not lie in fencing off areas of ground as British, French or German, which was so frequently done; but of so increasing the offensive power of weapons that their numbers can be reduced in defensive positions. For instance, in trench warfare, great risk was taken in placing a little wire in front of the front line fire trenches, which, more frequently than not, were a target for the enemy's guns. Instead, entanglements should be constructed behind these trenches, where acres can be set up in a single night. In front of the fire trenches, ground, for this purpose, is normally limited, in the rear of them, unlimited, and being so obviously the place for wire, is frequently overlooked. This error is mainly due to the spell of the cordon system, which aims at holding ground, as if ground were the object of battle; it is not, for its object is the destruction of the enemy's fighting strength.

To avoid the excessive use of men for purely defensive work, we have recourse to a very simple arrangement known as outposts. These perform two duties: the first, watching for the enemy; the second, delaying his advance so that the troops in rear may assume the offensive before the enemy can surprise them.

If in field warfare it has been found that seldom more than one-eighth of a force is required for protective duties, a greater number should be unnecessary in trench warfare, where defences and obstacles abound. True, in trench warfare, the opposing forces may often be as many yards apart as in field warfare they are miles; but military spaces are not measured with a foot rule, but by the obstacles they contain, and the time taken in crossing them.

In order to obviate the inherent disadvantages and vices of the cordon system of defence: first, the line of resistance must be chosen from the point of view of the grand offensive; and, secondly, from that of the decisive counter attack. The line of resistance should be a fortified line, and the ground behind it should be prepared:

(i) To aid the offensive forward of this line.
(ii) To assist the defence of the line itself.

In front of the line of resistance should be constructed a line of observation, consisting of a continuous trench line, or a line of posts. Between this line of observation and the line of resistance should be constructed a line of strong works, the tactical object of which is:

(i) To protect the observation posts if they are attacked.
(ii) To break up, like groins, an enemy's attack should it sweep through the observation posts, so that a counter-attack, from the line of resistance, may find before it a morcelated and demoralised force.

The ground between the observation line and the line of resistance should be prepared:

(i) To facilitate our own defensive.
(ii) To hinder the enemy's offensive.

Masses of trenches should be avoided, they deplete military endurance and also the national exchequer.

We now come to our last principle, the principle of co-operation. Before the outbreak of the Great War, the doctrine of the offensive, due to lack of logical thinking, grew top heavy through the defensive being ignored; during the war, the result of this was a chaos of defensive actions.

One system, even if an unsound one, is safer than a score of brilliant ones simultaneously attempted, because the former means unity of action, whilst the latter spells dispersion of force. We cannot afford to regulate our defences on guerilla lines. Given a doctrine, given a definite system of defence, based on the proved principles of war, this system should be applied to the whole of a defensive line, whether this line is five hundred yards or five hundred miles in length. This is sound generalship. Whatever the length of the line may be, it should be looked upon as an unit. that is, as one zone of possible attack. It should be viewed from an offensive as well as a defensive point of view, the frontage of ultimate attack should be selected in accordance with the objective, and its holding and decisive attacking forces distributed according to the principles of concentration and economy of force. Once viewed as an unit, it should be divided into sections, the extent of each being arrived at after a careful tactical study of the ground. Further, each section should, when possible, bear a direct relationship to the larger tactical units—divisions, corps and armies, and all sections should be placed under the command of their own generals and their respective staffs; and, as long as the line is held, these should be its permanent officials. The garrisons may come and go, but the staffs should remain; they form the skeleton of the whole defensive system, the garrisons being the changing tissues.

In trench or siege warfare, until each section is organised under its own fortress commander, and ceases to be a mere tactical "doss-house," the offensive will languish, for it cannot be carried out effectively on the maxims of partisan warfare—each unit undertaking separate operations, or hesitating to do so for want of faith in the commanders on its flanks.

To sum up:

(i) The objective must be decided upon.
(ii) The plan of defence for the whole front must be worked out.
(iii) The entire defences of the front must be placed under one comamnder.
(iv) The front must be divided into sections.
'v) The sections must be divided into sub-sections.
vi) The sections and sub-sections must have their own commanders.
(vii) The requisite garrisons must be placed under the orders of these officers.
(viii) The remaining troops must be kept in reserve under their own commanders and trained for offensive warfare.

In one word, "organise." The trenches must be looked upon as defended barracks, to and from which units may come and go without altering rules, structure and accommodation; and not as mere camping grounds where each unit selects its own pitch. This will lead to co-operation in its highest sense, for not only will all know what they have to do, but all will know that, as they are part of *one* organisation, those on their flanks will equally know it, and that all will act together according to *one* plan (and not a hundred and one), irrespective of reliefs, irrespective of changes.

2. *The Tactics of Trench Warfare.*

General Dragomirov once wrote, with reference to field defences: " Make the firing line at right angles to the direction you want to command, and see that the enemy is unable to enfilade this line. All fortification is contained in these two principles." Though this is correct, it is necessary somewhat to amplify this statement as follows:

(i) Trench systems must be planned so as to enable the offensive to be assumed from them.

(ii) Troops must be distributed so as to possess complete liberty of manœuvre behind the front held; for an attack is generally more easily frustrated by attacking the enemy in some other quarter. Frequently to meet it directly is to play into the enemy's hands.

(iii) Defensive lines must be planned with the idea of counter-attack, especially the rear lines, and the troops must be distributed in accordance with this idea. This means that all reserves—men, munitions, guns, etc.—are ready for immediate action, are mobile, and that the men are in a high state of training.

(iv) Minor attacks must be made in order to create a favourable opportunity for decisive action. A definite policy must unite them, so that they may improve the possibility of an eventual offensive.

(v) The defence must never be content with warding off the enemy's blows, for the object, the destruction of the enemy, forbids this.

(vi) Trench warfare must be looked upon as subsidiary to the ultimate destruction of the enemy's field armies. This being so, trenches must be garrisoned so as to enable sufficient men to be trained in field warfare.

(vii) Trench warfare must be based on the maxim that " the offensive is the soul of the defence "; trenches, in themselves, being merely a temporary protection.

iii) Defensive positions must be selected in view of economising personnel so that the power of the offensive may be increased. Consequently, before ordering new trenches to be dug, it should be remembered that every extra yard or two may mean one man less wherewith to strike a blow at the enemy.

(ix) Defensive frontages must be considered with reference to the offensive. At least half the total force should remain in hand for decisive action.

(x) Trenches must be dug with the object of reducing the number of men required for the defensive in order to add to the general reserve, or striking force.

(xi) The trench garrisons, those troops represented by sentries, picquets, supports and reserves, should seldom, if ever, exceed one-quarter of the total troops allotted to any one section.

(xii) As trench warfare adds little to skill, better organisation, training and *moral,* every attempt should be made to reduce the number of men employed in it, so that more can be trained for offensive action.

To return once again to General Dragomirov's maxim, for centuries past, in fact, from the earliest days of warfare, both his requirements have been met by disposing the defenders in such a way that they can take in flank an enemy's attack directed against their front or flanks.

There are two means of doing this:

(i) By the use of weapons.

(ii) By the use of barrier and deflecting obstacles.

To use weapons with the greatest effect, it is necessary to be shielded; therefore, in former times, walls or ramparts were built, and in order to enfilade an attack these walls were provided with bastions. In other words, a series of towers, or strong points, were linked up by curtain walls, and between these bastions were constructed sally ports, from which the offensive could be assumed. The entire work was surrounded by a moat, or ditch, which not only constituted an obstacle, but a trap, which once entered, was difficult to escape from, on account of enfilade fire sweeping it from flanking works.

Throughout the history of war, whenever an improvement in artillery has rendered the cannon superior to the musket or rifle, fortresses and field defences have abounded; and, if we want to study the principles of these defences in detail, we cannot do better than go back to the days of Vauban, and substitute, in place of bastions, strong points; in place of curtains, narrow trenches; in place of moats swept by grape shot, wire and trenches swept by machine-gun fire.

Analysed, all these systems may be reduced to three tactical factors:

(i) The maintenance of an unbroken front.
(ii) The enfilading of a hostile attack.
(iii) The rapid assumption of the offensive.

I will consider these in turn.

The Maintenance of an Unbroken Front is generally dependent on the denial of flanks to an enemy's attack. This may be accomplished by:

(i) A continuous system of trenches.
(ii) Detached works linked together by wire entanglements.

If the enemy is to be attacked, the advantage of the first system needs no explanation, for a continuous line of trenches is a necessity as a jumping off line. If the enemy is simply to be withheld, the advantage of the second system is that it requires very few men for defensive work, consequently, it permits of the majority being relegated to the offensive reserves. Its disadvantage is that vast fields of entanglement, and the absence of lateral communications, seriously impede our own advance and assault.

Considering these points, there can be little doubt that for those sections of the front which have been selected for offensive operations, the system of the continuous line is best; and, as men are never unlimited in number, it will, consequently, be necessary to adopt the system of detached works for those sections of the line which are purely defensive. Unless this rule be strictly observed, the principles of concentration and economy of force will be violated.

If this contention is correct, it follows that, whenever the conditions render the offensive either impossible or ruinously costly, it is only right to adopt the second system in place of the first, for, by so doing, endurance will be economised. The most important condition which regulates this adoption in Western Europe is weather; consequently, during the winter months, the system of detached posts should, when possible, be adopted.

What did the Great War teach us of entrenchments from the constructive point of view? This: that though it is possible to dig hundreds of miles of trenches in the summer, it is next to impossible to maintain hundreds of yards in the winter, unless these trenches are solidly revetted, and boarded, and carefully drained. When trench systems run into thousands of miles, seldom are material and labour sufficient to complete all the trenches dug during the summer, or to maintain them during the winter. The result is that, though in places the system of the continuous line is suitable during the summer-time, it is not only unsuitable during the winter, but a positive danger, for the more it is patched up the more it falls in. When once a trench is half-full of water, unless this water can be removed by drainage, and it often cannot be, nothing destroys it more than trying to clear it out and revet it; every soldier knows this.

It would appear, therefore, that when once the offensive is brought to a standstill through the opposing forces going to earth, the defining of the zones of attack and defence should be a commander's first consideration; and that, until these have been defined, no elaborate system of trenches should be dug, so that every board, every hurdle, every gabion may be economised in the purely defensive zones in order that the trenches in the offensive ones may be made to withstand the rigour of the winter and be in a fit condition to aid an early spring advance. Further, the less work required during the winter, the more men will the units, destined for the offensive, be able to train. We should rely on weapons as the best means of defending the offensive zones, and on obstacles for defending the defensive zones, because our own weapons are the best means of aiding our advance, whilst our obstacles often impede our movements as much as they impede the enemy's. During the winter time it is generally feasible, temporarily, to convert such positions of the offensive zone, as are rendered unattackable on account of weather, into defensive ones; and though this may mean that many of the trenches necessary to an offensive will fall in, these can be more thoroughly repaired during the first fortnight of fine weather than during months of rainy.

In fact, the entire problem of defence is one of the most rudimentary common-sense; it may be summed up as follows:

(i) Trenches from which an offensive may be launched should be defended by missiles, consequently a continuous line is necessary.

(ii) Trenches which are purely defensive should be defended by obstacles flanked by fire, consequently detached posts (well hidden machine-gun blockhouses) are equally so.

(iii) During the summer an army should be prepared to assume, or repulse, an offensive.

(iv) During the winter an army should be prepared to assume an economical defensive, that is, one which will require as few weapons as possible so that a maximum number of men may be trained for offensive action during the following summer.

The Enfilading of a Hostile Attack.—The power of enfilade fire cannot be exaggerated in trench warfare; in the offensive it constitutes the chief means of accelerating an attack, in the defensive of frustrating it. This is not usually observed on account of the obsession that parallel entrenchments are the surest means of defence. As the flank of an attack is the most vulnerable point, our tactics should aim at forcing an enemy, should he attack us, to offer us a flank in such positions as will cause him the greatest inconvenience and loss. If nature does not provide us with these positions, then, by the aid of obstacles, must we create them; we must so place our entanglements that they will not only come as a surprise to the enemy, but will force him to halt in such positions as will render his flank, or flanks, an easy target to our fire.

Take, for instance, the wire entanglement in front of a fire trench. If, instead of constructing it parallel to the trench it protects, it is constructed in a zig-zagged manner, it will not only form a more difficult target to the enemy's artillery fire, but it will enable an enfilade and cross fire to be directed along its salients. Again, if behind this entanglement we dig an observation trench, this also should consist of a series of salients or untraversed zig-zags, in principle much like the old pentagonal fortresses of two hundred years ago. Such a trench will not only flank the wire, but will, in itself, constitute an obstacle, for internally it can be flanked by rifle or machine-gun fire. Every trench dug should help the offensive. If lost, its existence should at once add to the strength of the defensive; this is the whole art of entrenchments.

If between the lines of observation and resistance, an intermediate line of works is constructed, these works should be so sited as to cause the enemy, should he attack them, to form perpendicularly, or obliquely, to the line of resistance, and so lay either one or both flanks open to counter-attack.

Siting of wire and siting of fire trenches is simply a matter of common-sense, based on the simplest of simple maxims, namely: All obstacles and trenches should be so sited as to cause the enemy to offer a flank to our fire without compromising the advance of our counter-attack.

The Rapid Assumption of the Offensive.—The possibility of rapidly assuming the offensive depends on distribution, ground and observation. Should the front line be made the line of resistance, the offensive may be rapidly assumed from this line if our observation be good and the enemy's bad; but, should reverse conditions prevail, it is probable that the garrison will be pounded to death before an offensive can be launched. If a rear line, not observable by the enemy, is chosen, then the ground between it and the front line must be sufficiently clear of obstacles to permit of a rapid advance. The chief reason why a rear position should be chosen for resistance is that whilst the front line is immediately restricted by the proximity of the enemy's trenches, a rear line is not so affected, and the further back this rear line is dug the more room is there wherein to manœuvre entanglements.

The manœuvring of entanglements, with a view to disorganising an enemy's attack, and facilitating our own counter-attack and offensive, is a point which has not met with sufficient recognition in the past.

3. *Siting and Garrisoning Trenches.*

As a trench is virtually a shield, it should be dug where it will provide the surest protection against whatever weapon can do its occupants the greatest harm, and also assist in the development of the power of such weapons as will prove most effective against the enemy. In a war of trenches, excluding mechanically-propelled weapons, such as tanks, it is the gun and howitzer which to-day rule the field, consequently the soundest plan is:

(i) Offensively, to select for artillery the very best observation positions possible, positions from which those of the enemy can be commanded.

(ii) Defensively, to site infantry trenches in places where they cannot be directly observed from the enemy's artillery observation posts.

If this is done the principles of the offensive and security will be maintained, namely:

(i) The destruction of the enemy, or the maintenance of a position from which the maximum artillery effect can be obtained.

(ii) The protection of ourselves, or the maintenance of a position against which the minimum artillery effect will be felt.

Subsidiary to these are the following:

(i) The selection of a position which will enable our guns eventually to advance rapidly and safely.

(ii) The selection of a position which will not permit of the enemy's guns doing likewise.

Combined, we obtain the following theory:

That a position to be considered sound must be one which cannot be enfiladed, but which will facilitate our artillery enfilading the enemy, whether stationary or advancing; further, that it will facilitate our advance by securing our batteries from enfilade fire when they move forward.

A position should first of all be looked at from our possible observation posts, next from those possible to the enemy, and only then should trenches be sited. This system is always practicable in the case of rear lines of defence. The front line, the siting of which is often governed by the enemy's position and opposition,[1] should, as far as possible, be treated in the same way. A position should always be considered from the point of view of enfilade fire, particularly that of artillery and machine-guns. Purely parallel systems of defence should seldom be allowed. When such are inevitable, they should be connected up by a system of fire-communication trenches which divide the spaces between them into a series of fortified triangles and quadrilaterals. A system of trenches should always be sited so that at least a part of it commands a direct view of the enemy's position, whilst the remainder affords direct protection against his fire.

Having sited our trenches the next question is to garrison them.

The correct manner of garrisoning a line of trenches depends entirely on the purpose for which the trenches are dug, whether for an offensive or defensive operation. If offensive, the strength of the garrison may roughly be arrived at by weighing the conditions of numbers, ground and armament, that is, by calculating how far these favour the enemy or ourselves. If defensive, then the number of detached posts requisite to enfilade the wire fields. Thus, by an application of principles to conditions, may economy be effected and guessing reduced to a minimum.

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[1] In the Great War, most front lines had little relationship to security, as they were generally entrenched field battle fronts.

The front line should be looked upon as an outpost line:

(i) When a strong line of resistance runs behind it.
(ii) When the front to be held is purely a defensive one.

The front should be looked upon as a battle front when it constitutes the line of resistance itself. Resistance, here, being interpreted in a two-fold sense:

(i) Resistance due to the formation of the ground.
(ii) Resistance due to the intention of holding the front line offensively.

In trench warfare, as in field, the whole question of holding the front line may be summarised under outposts and battle outposts. In field warfare the former are used when the opposing forces are so placed that they are unable to attack one another without giving some warning of their approach; the latter, when a surprise attack is possible, that is, when the enemy, in force, is close to us and few obstacles lie between us and him, and, further, when the ground which we occupy is of great tactical value.

By combining these two systems we get a third, which admits of both being adopted according to circumstances. This system demands the most careful co-ordination, for being based on a dual conception of defence, it is liable to lead to doubt and disorder. To control it we must fall back on our principles and consult these: determine our zones of offensive and defensive action, consider conditions and then plan accordingly, making certain that every commander knows what he has to do, and only allowing those commanders to adopt the outpost system in such zones in which a retirement of the garrison will not uncover the flanks of the sections on its right or left, or will create for the enemy's attackers a *cul-de-sac* completely raked by enfilade fire.

To return to the heading of this chapter: All the above elaborate defences and defensive systems were due to one factor only—the bullet. It was the bullet which, in 1914, drove men to earth, and kept them there for over three years; I will, therefore, now turn to this most powerful of modern weapons, and briefly examine recent history.

CHAPTER II.

THE REIGN OF THE BULLET.(1)

Without fear of contradiction it may be said that since the introduction of firearms the influence of the bullet has been the outstanding problem of the battlefield. Nevertheless, this problem has to a very large extent remained occult, with the result that until the introduction of the tank, all solutions failed, and even to-day, though half an inch of steel is a definite answer to the bullet, it is not generally accepted as such. It is considered, therefore, that as half an inch of steel is going to alter all our tactics, it is not only interesting, but instructive, to discover how it came about that half an ounce of lead completely transformed the tactics of a hundred and twenty years ago. If it can be shown, and there is really nothing new in this, what half an ounce did in days gone by, then those who at present refuse to accept what half an inch will most certainly do, may possibly be persuaded to lessen the dogmatism of their opinions.

1. *The Influence of the Bullet,* 1800 *to* 1905.

In the year 1800 the effective range of the musket was about 100 yards; the rifle as a military weapon was in its infancy, and the bayonet was supreme, for the assault was not only of common occurrence but the true end of every fight. Co-operation between the arms was simple; the artillery were with the infantry, either in front of the line, or on its flanks, or in the intervals between the units composing it; the cavalry were close at hand, and frequently decided the battle, especially in rainy weather, for then it was normally impossible to discharge a flint-lock musket.

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(1) *The Fighting Forces,* October, 1927.

The first change came with the percussion cap which was invented by Thomas Shaw of Philadelphia in 1814. It was not adopted, however, by our army until 1839, when the cock and pan were replaced by a hammer and a nipple. The influence of this invention was radical, for close co-operation between the three combatant arms now began to fray away, since the main object of cavalry—the charge—was on account of it circumscribed and restricted. This invention was followed by extensive improvements in the rifle, mainly due to the perfecting of gunpowder, and the introduction of the cylindro-conoidal bullet. The Minié rifle, a French invention, was issued to our Army in 1851, and it was sighted from 100 to 1000 yards. Here another radical change was introduced. The gunner could no longer stand in front of, or alongside, the infantryman, but had to get behind him, and well behind him. Thus the whole complexion of tactics was changed. In 1815, infantry, guns and cavalry all fought more or less together. they were, broadly speaking, one conglomerate whole, and so completely under the eye of the general-in-chief that co-operation depended on his word—normally it was immediate. By the middle of the nineteenth century, though old tactical methods were generally attempted, the mass had very largely dissolved and reformed itself into three separated lines. The bullet had, in fact, taken an unconscious charge of the battlefield, and whatever the soldier dictated, its word was law. The infantry struggle was now *the* battle, the artillery and cavalry standing behind, the one attempting to protect the infantry, and the other ever ready to take advantage of any infantry success. The general-in-chief now ceased to be the pivot of co-operation, he could no longer regulate the actual battle, all he could do was to intervene with his reserves.

As the range of the bullet increased, the more prolonged became the infantry fire fight, and the farther had the artillery to get in rear of the riflemen, and the further they retired the more had they to increase the range of their guns. The problem of artillery co-operation now became so difficult that towards the end of the century, when rifles were sighted to ranges of 2000 yards and upwards, the gunner began to think of indirect laying, for otherwise he felt that he would be driven out of the battle zone altogether. The cavalry definitely went into reserve, and ceased to co-operate tactically until the fight was over, for they could only charge shattered fragments.

In spite of the War of Secession, the war of 1866, and the Franco-Prussian War, still at the end of the century was the influence of the bullet little understood. In South Africa it completely surprised us, and the result was that not only did the infantry firing line dissolve into an unmanageable skirminishing line, with from ten to fifty paces between men, but co-operation between the arms was all but reduced to zero. This led to block-house warfare and mounted infantry drives, artillery all but fading out of the picture.

Scarcely had this war ended than the changes wrought by the bullet since 1840 began to manifest in Manchuria. The assault became increasingly difficult, in fact, it now constituted the exception and not the rule. The charge disappeared altogether, and the problem which loomed immense over the horizon of every battlefield was that of artillery co-operation, for a new bullet thrower, the Maxim gun, rendered frontal attacks costly in the extreme.

A complete change in tactics now set in. As more often than not frontal attacks could not be avoided, and as the infantry attack frequently occupied days, trenches were thrown up on every battlefield, enveloping movements being attempted on their flanks. In fact a war of movement became tantamount to a war of envelopment, and this can be readily discerned should the reader care to study the various tactical manuals written immediately after the Russo-Japanese War. Envelopment not only depended on finding a flank, sometimes a difficult task, as at the battle of Nanshan, but on pinning down the enemy; for if the frontal attack failed to do so, as it normally did (*e. g.* The Yalu, Liaoyang and Mukden) he slipped away before the enveloping forces could outflank him, retired, and took up another entrenched position. To protect himself, the gunner began to seek positions behind undulations and hills, and to fire over them. He could not well sink his gun into a trench, nevertheless his tactics and positions became more and more those of trench warfare.

2. *The Influence of the Bullet,* 1914-1918.

We see now a totally different form of war from that which existed in the days of Napoleon, consequently the study of his campaigns is no longer of much tactical value, nevertheless, even ten years after the conclusion of the Manchurian War, the tactics of France and Germany are based on his campaigns. In his day, as I have already stated, the conglomerate mass of all arms was operated rather than co-operated by the general-in-chief. In 1904-05 one side is nearly always entrenched and the trenches are wired. The other side is extended a thousand yards from its enemy's position. The guns are a mile or more in rear of each line, and constitute an independent line of their own. The cavalry are either immobile and in reserve, or on one or both flanks scouting in front of an enveloping force, or a force which will check envelopment by extending the front attacked. The general-in-chief is frequently many miles in rear of the battle-field, he has now lost all personal contact with the fighting troops, and attempts to maintain touch with local affairs by telephone. Only one thing keeps movement fluid, and so denies to the bullet complete sovereignty over affairs. This is an open flank, or flanks. Let one side assemble sufficient rifles and machine-guns, or let the battlefield be too narrow for the full deployment of the combatants, or girt by impassable obstacles, then the attack must become as static as the defence. This was one of the great lessons of the Manchurian War, and it was all but lost on the General Staffs of Europe. Ever since the middle of the nineteenth century the bullet had whispered louder and louder, until in the first years of the twentieth it shrieked : " Halt ! advance at your peril ! " Yet between 1905 and 1914 every army in Europe was preparing for a mobile war, not a war of trenches, but a war of manœuvre, a war of Napoleonic strategy which was impossible without Napoleonic tactics—indeed an astonishing example of studying, and worse still digesting, military history upside down. Then came the Great War, and a sufficiency of men was found to exclude flanks; the result was a complete surprise, though it should have been a foregone conclusion that the war would rapidly crystalize out into an immense siege operation.

Should the reader visit the great cemetery of West Norwood, there he may see a block of grey granite upon which two words in large black letters are cut, these are : " HIRAM MAXIM "—the god of the Great War, the modern manifestation of Mars. In 1914, he was an old man, aged 74, and in 1911 he was considered of so small account that only twenty-seven lines are devoted to him in the Encyclopædia Britannica (four more than to Dan Leno), yet his invention, dating back to 1884, had a greater tactical influence on the war than any other, for walls of men were replaced by zones of fire. It was no longer a question of covering the battlefields with men, but with bullets, and so completely were they covered that the infantry assault becomes almost as great an exception as the cavalry charge, consequently, the main task, that of breaking the enemy front, was handed over to the artillery.

From the battle of the Aisne, in September, 1914, the importance of artillery increased daily, until, by the spring of 1915, every attack depended for success not on the rifle, but on the gun, success being limited to the range of shell fire, when the rifle and the machine-gun once again came into their own. To trace in detail the growth of artillery between 1915 and 1918 is not my object, which is to accentuate that this growth was mainly due to the bullet. Besides multiplying artillery power many times, and completely changing artillery tactics, it was due to the resisting power of the bullet that gas was used as a weapon, and that the tank was invented. The former was an indirect, and the latter a direct answer to bullet-power protected by trenches and wire entanglements. The former directly struck at the soldier and entirely ignored his weapons; the latter at his weapons, especially rifles and machine-guns, since the bullet could do the tank little or no harm. Against lethal gases protection was soon discovered, and the result was that the chemist turned to vesicant compounds against which the respirator was powerless. The second accelerated the importance as well as the limitations of the gun, and in consequence towards the end of the war gunners were beginning to change their tactics. As tanks could replace the artillery barrage and blaze a trail through the enemy's wires and trenches, the gun in place of covering the infantry advance covered the tank assault, hence the importance of the smoke shell was increased, since to cover the advancing tanks by a barrage of H.E. shells was out of the question, unless the advance was methodical in the extreme. Whilst in 1915, 1916 and 1917 entrenched fronts could, at best, be bent by artillery fire, in 1918 they could be penetrated at any moment by a tank attack. The reign of the bullet was at an end, in fact General Swinton had dethroned Hiram Maxim.

As is always the case, the positive power of one invention created the negative power in another. The bullet had at length suggested the idea of bullet-proof armour, it was the simplest possible answer, and in it lurks a complete change in the theory of war, which henceforth will include whole areas, and not merely two opposing lines. In the future, battles on land will closely resemble battles at sea, and all this has evolved from out the bullet.

3. *Return to* 1914 *Tactics in* 1919.

Be this as it may, in 1919, all great armies reverted to their 1914 organisations and tactics. If after the Russo-Japanese war the tactical tendencies of that war were unobserved by the General Staffs of Europe, how much more astonishing is it to-day to realise that in 1919 the concrete tactical facts of the Great War have been entirely lost on these Staffs. In place of reorganising on these facts, they one and all cut down their artillery, cut down their tanks, abandoned gas, reduced their aircraft and resuscitated their doctrines of a war of mobility based on infantry fire-power.

In theory such a doctrine is excellent, for movement is the soul of war, but how infantry were to advance against a vastly increased bullet-power, when compared to that of 1914, and supported by fewer guns than existed in 1914, was not explained, nor was an explanation possible. There was no explanation, in place there was dogma, and dogma unsupported by facts, reason or imagination.

The difficulty to-day is once again the bullet, not that a solution does not exist, but that the traditionally-minded soldier will accept no solution. He is as impervious to new ideas, or even to self-evident truths, as was the Chivalry of France in the fourteenth or fifteenth centuries. From the battle of Crecy to that of Agincourt, separated by nearly seventy years, the French knights refused to acknowledge the power of the long bow, in spite of the fact that it destroyed them by hundreds, and to-day their modern prototypes refuse to acknowledge the power of the tank, in spite of the fact that every well-mounted tank attack was an overwhelming success. To-day, all the weapons which the war forced to the fore have been relegated as ancillary to infantry. To a certain extent this is correct, for the other arms have been so reduced in strength since 1918 as to be incapable of independent action, or of playing a leading part in battle. Equally is it true that on account of their weakness, infantry is as limited in its powers. It is not that infantry will in the near future be opposed by masses of guns, or large numbers of tanks, or immense clouds of gas, but that machine-guns will spring up everywhere; in a word, the bullet will once again reduce them to immobility.

The immediate tactical problem to-day is not mechanical warfare; not that this form of warfare is undesirable, but because soldiers will not accept it; they will not forego their prejudices and interests for a new idea which in their own estimation will throw them out of work. What then is the solution, unless it is accepted that we must be slaughtered wholesale, and that war is but the butcher's trade?

The solution is that we must accept man as he is made, a conservative creature. Apparently we must work on the ancillary "stunt," and never hint that the majority—the infantry—can ever be other than in the right. We know that half an inch of steel will keep out a bullet, and that the defeat of the bullet is still the infantryman's problem. We know that to armour the bulk of the Army is out of the question, because a mechanical army requires a mechanical base of action—workshops, repair depôts, etc., etc., and before money can be found to pay for these, the infantry will have to be reduced. Evolution must therefore be slow, since every step forward will have to be fought for, yet we can do something.

I suggest that we accept the Army as it is, an organisation composed of cavalry, infantry and artillery, and then equate each arm with the bullet. I will now examine a normal operation of war.

The cavalry move forward with comparative ease until they "bump" the bullet, when their movement forward ceases. The infantry follow them, and all goes well until they "bump" the bullet, then they are slaughtered, or they retire, or dig in, or attempt to manœuvre; but to clinch with the enemy, if he is of any worth whatever, is impossible, because the bullet forbids it. To overcome this difficulty the gunner is called upon to deal with the bullet. There is a machine-gun firing from a copse; where in the copse is not known to the infantry nor to the gunner; so all the gunner can do is to bombard the copse. This may require a large number of guns and considerable time, further, the machine-gun may or may not be destroyed or dislodged. No sooner is it silenced than another machine-gun opens fire; the process is repeated, and as an infantry division to-day contains some 500 automatic weapons, once the bullet takes charge of the battlefield there is no advance, or an advance so slow as to be unremunerative. Above all be it noted that it is not the infantryman who tackles the machine-gun, but the gunner.

The difficulty of both the infantryman and the gunner is similar, they cannot approach *close* to the machine-gun, in fact *they cannot hunt it.* The only weapon that can do so is the tank, and to send forward a machine, such as the Vickers tank, a machine costing nearly £8000, to hunt every machine-gun which opposes an infantry advance is to ask for trouble. First of all the tank is not an infantry arm, it is an ancillary; secondly, it is a big target and should it normally be used to hunt machine-guns, the enemy will soon tumble to it that it may be profitable to use machine-guns as bait, the hook being field guns concealed in their vicinity. If by some jugglery the tank could be made an infantry arm, the first difficulty would be overcome, and if it could be reduced in size, the second would be mitigated. This introduces the light tank, or tankette, a new weapon invented since the war.

4. *The Conquest of the Bullet.*

In my opinion the tactical uses of the light tank are likely to prove revolutionary. Its proper place is obviously with the heavier machines, but I am accepting the army as it is and not as it ought to be, therefore, to begin with I will hand it over to the infantry and cavalry, and suppose that an infantry battalion and a cavalry regiment each possesses a company of 16 of these machines, which are part and parcel of their respective organisations.

Turning back to the above normal operation of war, when the cavalry come up against the bullet, they will send their light tanks forward, which after dealing with the situation will emblazon victory on the cavalry standards. To-day, horse artillery attempt to do this but fail, since in place of being in front of the mounted men, perforce they are behind them, or on a flank. What cavalry require is not a distant pivot of manœuvre, but an offensive shield in front of them. They want to see their supporting guns as close to them as at Waterloo, and they want to be so close to their enemy that they can see the white of his eyes. Then, once the guns have fired, there is a possibility of couching lance. The horse guns cannot be close beside them, but the light tanks can be, for they need no cavalry screen to protect them as the guns do. If the hostile riflemen refuse to approach near enough for their eyes to be seen, all the light tanks have got to do is to advance, yet whether this will really prove successful is doubtful, for the enemy's heels will be seen long before his eyes are, and when they are seen the "pig-sticking" operation can begin. A battalion pursued by a company of light tanks followed by several hundred horsemen with lances couched is a possible operation of war, not that I see any reason to use these picturesque weapons, but a regiment of present day cavalry charging infantry under the covering fire of a battery or two of horse guns is a figment of the imagination. The whole of this problem is one of defeating the bullet; if the bullet can be defeated the cavalry can still charge.

With the infantry the problem is much the same. What was the difficulty? The bullet, especially the machine-gun bullet; and again, if the guns could be with the infantry, and the enemy's machine-guns are 300 yards away, the gunner could undoubtedly provide an answer to this problem. But the gunner cannot be close to the infantry, but must be a considerable distance in rear, and the enemy machine-gun is probably over 1000 yards away. The light tank can be with the infantry, and as an armoured scout it can advance ahead of the infantry and stalk the enemy machine-guns. Further, if the enemy uses his machine-guns as artillery bait, let him beware, the light tank is a difficult target to hit, it is cheap, it only contains two men, and a section of these weapons—say four—should normally be able to take on machine-gun and gun simultaneously. To risk losing a field-gun and a dozen gunners for a Vickers tank is worth while, but to risk their loss for a tank costing £1000 and manned by two men is not worth while; better remove the gun and replace the machine-gun by a light tank. If this is done, and light tank meets light tank, what will the gunner do?

He cannot support the infantry, for the infantry do not want his support, their light tanks are supporting them by defeating the enemy's bullets far more expeditiously than his guns can. If the enemy's guns are active, the infantry may ask for counter battery fire, this is all. He cannot support the light tanks, in all probability he will not even know that they are out, in any case he will seldom know how they intend to manœuvre. He cannot hit the enemy light tanks for they will constantly be changing their position, and he cannot well engage in the light tank *v.* light tank duel as he will not be able to distinguish friend from foe. Except for counter-battery work and the occasional firing of smoke shell he is useless unless he can come close up to the infantry, for should their light tanks be destroyed they will be easy prey to the enemy light tanks, and would feel far safer if the guns were alongside them. Join them they can if they mechanise and armour themselves. This means that they must evolve into heavy tanks.

The tactical outlook has now again changed. We have light tanks fighting light tanks, which presupposes that each will be equipped with anti-tank machine-guns, and on both sides these machines will be supported by heavy tanks. Somewhere in the offing will cavalry be sticking panic-stricken enemy riflemen routed by the cavalry light tanks, whilst well in rear, on some anti-tank hill top, will be congregated the infantry, loudly applauding this excellent sport. Such I believe is what a battle will look like in the near future.

It may be argued that all this is absurd, but it is not. Such a battle as I have just depicted is far more rational than a return to the battles of the Great War, and if the infantryman was then unable to close with the enemy, how can he do so to-day, seeing that at least three times as many bullets will be fired on the battlefield? The above battle may not be the most rational of possible battles—I agree. But the present day soldier will not have possible battles, he believes in mythological battles, for he is a super-visionary—cavalry can still charge and infantry can still close, surely such conceptions are in cold fact visions indeed, dreams transcending anything dreamt of by the tank, gas and air merchants.

Such then has been the influence of the bullet on tactics during the last hundred and twenty years. It changed cavalry tactics, then infantry tactics, then artillery tactics, and consistently it has gone on changing them. Yet the whole power of half an ounce of lead depends on one thing only, namely, the penetrability of human flesh. Half an inch of steel can remedy this natural defect, and when this is realised, and—more than realised—accepted, the reign of the bullet will come to an end, and the art of war will have completed yet another lap in its tortuous and interminable course. If not, I see no alternative to the costly tactics of penetration attempted during the war.

CHAPTER III.

THE TACTICS OF PENETRATION.(1)

For many years before the outbreak of the war in 1914, the grand tactical idea which dominated military thought was that of envelopment. Personally, a close study of the envelopments attempted during the Russo-Japanese War led me to expect that in the next war this method of victory would be more difficult to apply with decisive results than it had been in the past, and in April, 1914, I wrote an article, bearing the same title as the present one, which was published in the Journal of the R.U.S.I. of November, 1914. My reasons for doubting the official doctrine of the day were: That the size of modern armies was likely to impede rapidity of manoeuvre and control; that trenches and wire were easily constructed and powerful obstacles, and that the machine-guns and quick-firing artillery, if massed, should be able to blow a hole through an enemy's front. Though, to-day, my opinions differ considerably in detail from those I held in 1914, my main point, namely, that the modern field-gun had become the superior weapon of war, I consider was correct. Further, I am still of opinion that this will hold good until such time as armies mechanise, when tactical envelopment will come back into its own.

1. *Strategical Conditions on the Western Front.*

To understand the problem of tactical penetration which faced the French and ourselves from November, 1914, onwards, it is necessary to visualise correctly the nature of the strategical conditions which existed on the Western Front. Here, in August, 1914, German strategy was largely influenced by the strategic salient in which the French Armies were compelled to deploy, namely, the Belgian frontier from the Channel to Longwy, and the German frontier from Longwy to Basle. By the end of October, the race to the coast was completed, and this salient was replaced by one of a tactical nature, a trench running from Nieuport *via* Arras to Noyon, thence *via* Reims to Verdun and from Verdun to Basle. The sector Verdun-Basle was of little tactical importance compared to the salient Nieuport-Noyon-Verdun which may be divided into three areas—the Flanders area on the northern flank, the Ardennes area on the southern, connected by an area of open country in between, the axis of which is traced by the rivers Oise and Sambre. Flanders and the Ardennes are obviously good defensive areas, for both are a mass of obstacles—dykes, canals, scattered farmsteads in the one, and mountains and forests in the other. The Sambre-Oise is a natural and historical approach into north-eastern France, and the areas these rivers run through may be classed as good offensive country.

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(1) *The Journal of the Royal Artillery,* July, 1926.

Across the salient Nieuport-Noyon-Verdun runs the railway from Thionville, Mézières-Valenciennes to Lille, and from it southwards and westwards run a great number of lines. Its two most important junctions are Mézières and Valenciennes, and they lie on the inner flanks of the two defensive bastions—Flanders and the Ardennes. The first is 35 miles from Arras and the second 45 miles from Reims. The Thionville-Lille line was vital to the retention of the salient by the Germans, for if either Valenciennes or Mézières was lost, the result must inevitably lead to an evacuation of the greater part of north-eastern France; if both were lost then to a retirement to the line Antwerp-Brussels-Namur-Thionville.

In November, 1914, the tactical problem which faced France and ourselves was how to pierce the Nieuport-Noyon-Verdun salient, for envelopment was no longer possible.

2. *The Spring Offensive,* 1915.

The closing operations of 1914 showed that infantry were incapable of penetrating a trench line defended by wire and machine-guns; that the attack must become more methodical; that strong forces must be concentrated at one point, not many, and that the infantry assault should be prepared by a heavy surprise bombardment carried out by as large a force of artillery as it was possible to assemble.

The British spring offensive opened with the remarkable little battle of Neuve Chapelle. Only two divisions were employed on the first day, and the frontage of attack was about 3500 yards; yet thanks to an intense and rapid bombardment, which lasted about 35 minutes, a definite penetration was effected.

This battle was mounted on a correct understanding of what penetration required, namely, surprise; but the frontage attacked was so small that it was doomed to failure; nevertheless the idea underlying it was greatly in advance of anything attempted on the Western Front since the battle of the Marne.

The battle of Neuve Chapelle, which was fought on March 10 to 13, was followed, on April 22, by the German attack at Ypres, in which gas was for the first time used on the Western Front. The attack came as a complete surprise. A small penetration was effected, but once again the gap was rapidly blocked.

The main spring offensive opened on May 9 by a conjoint attack of French and British forces in Artois; the former directing their operations towards the Aubers Ridge and the latter in the direction of Lens. The French attack is of some interest as it shows that method is rapidly replacing surprise as the main idea of the attack. The trenches are carefully prepared, the reserves being accommodated in the trenches themselves. A preliminary bombardment lasting six days is carried out by the artillery of three corps supported by 350 heavy guns and howitzers on a front of 16,000 yards. The only surprise to the enemy was the hour of the assault, which, when made, effected a penetration of some 3,000 yards on a frontage of 6,000. The result was distinctly disappointing. The French reserves were delayed in getting out of the trenches, and the Germans rapidly closed the gap. Method in this battle had in fact been less successful than surprise at Neuve Chapelle, and it cost far more in casualties.

The lessons which the French deduced from this battle were as follows:

(i) Penetration by frontal attack is only possible if the attack is methodically prepared.

(ii) Preparation entails a prolonged and accurate bombardment which will obliterate the enemy's defences.

(iii) Obliteration must be carried out on a front of sufficient width to leave a zone unswept by the enemy's fire in the centre of the salient formed by the attack.

(iv) The front to be attacked should be free from villages and strong tactical positions.

(v) The reserves must be so placed as to be able to take immediate advantage of the penetration.

Nothing was said, as far as I know, about surprise, and yet surprise was the one thing required.

3. *The Autumn Operations,* 1915.

So far the battles had been made against one point and all had resulted in failure. Now the idea of a dual penetration was to be tried out. In brief this theory was, and I shall examine it more fully later on, to pinch off the Arras-Noyon-Reims salient by two attacks, one from the east and one from the south, the axes of which would meet at about Namur.

A dual attack of this nature was launched on September 25. The eastern attack was carried out by British and French forces at Loos and in Artois, and the southern by a French force in Champagne.

The Champagne attack was the most important operation yet mounted. General Pétain was allotted 30 infantry divisions and 7 cavalry divisions, and in all he had under his command some

3,000 field, and 2,000 heavy guns. The front of attack, which ran from Main-de-Massiges to d'Auberive was about 26,000 yards wide, and had been selected from the point of view of eventual cavalry action.

Opposite this front the Germans had constructed two systems of defence, the second some 5,000 yards in rear of the first. To penetrate these, a prolonged bombardment would be required, as both were to be simultaneously destroyed, for it was intended to push the infantry attack through in one bound. In fact the infantry objectives were unlimited.

To use infantry in this manner was to ask for trouble, and the French certainly got it, for by the time their troops had penetrated to a depth of some 3,000 yards, such disorder had developed that the attack came to a standstill. Nevertheless, 15,000 Germans were captured as well as 100 guns.

The French now examined their failure, and came to the following conclusions:

(i) That there had been a lack of co-operation between the artillery and the infantry, and that in future the only duty of the field guns is to support the infantry.

(ii) That the reserves should not be placed in the same area as the attackers, for if this is done they will be disorganised by the counter-bombardment of the enemy.

(iii) That, if the second line of the enemy's defences cannot be reached by field but only by heavy artillery, it should not be attacked by infantry.

(iv) That it is not possible to carry two defensive systems in one bound, and that directly the first is captured a methodical attack must be mounted against the second.

(v) That a successful attack inevitably demands severe loss of life and an enormous expenditure of gun ammunition.

After this attack General Pétain laid down that attacks against entrenched positions should be divided into two phases:

Attrition: "The attrition of the enemy will only be effected by a general pressure of all the allied forces, an operation which would aim at occupying objectives of limited depth without attempting to effect a penetration."

Decision: "When the attrition of the enemy is considered to be sufficient, then only will the decisive attack begin, and it should be launched from several well chosen positions in successive assaults on frontages of at least 20 kilometres."

And now briefly to review the changes of tactical ideas during this year. The year opened by vain attempts to hurl men through barbed wire. Little by little it was discovered that it was no longer the infantry who attacked but the artillery; that it was first necessary to destroy the defences of the enemy before attempting to capture them. The lesson of this year in fact was: "Artillery conquers and infantry occupies." Tactics were thus reduced to a matter of push of pikes, or rather push of shells; drill took the place of manœuvre, method of surprise, and shell fire replaced leadership. Tactics were, in fact, reduced to the level they held under the Spartans in the fifth century B.C.

4. *The Battles of Verdun and the Somme,* 1916.

The failure of the unlimited infantry attack, and the preponderating influence of artillery on tactics, introduce the period of the great artillery battles in which infantry move at a slow march behind hurricanes of shells, and merely collect prisoners, or occupy positions, without fighting. Since 1914 the whole aspect of tactics has changed, and these changes reach their culminating point in 1916.

During this year two stupendous battles of attrition are fought on the Western Front, namely, the battles of Verdun and the Somme. I will now outline their character.

The first of these battles was a strategical defensive operation carried out to frustrate and delay the projected attack of the French and British Armies, and so gain time for the Germans to finish with Russia. The battle of Verdun opened on February 21 with a surprise attack, for though the French knew that an attack in this area was impending, they expected it to open with the usual prolonged bombardment. In place, after a violent cannonade, lasting only a few hours, the infantry attack was launched, and succeeded in making considerable headway, not so much because the German guns had destroyed the French wire and trenches, but because the garrisons of these trenches had been demoralised by the intensity of the bombardment. By the 24th, Verdun itself was in danger of being captured, but the French had now recovered from their initial shock, and every further attempt was frustrated in spite of the fact that the battle was continued for another four months. In all, a penetration of 12,000 yards was effected at a cost of some 500,000 men to the Germans, and probably not less than 350,000 to the French.

The battle of the Somme was first considered in the autumn of 1915. The attack at Verdun in February upset, however, all plans, as the British army had to extend its front by relieving the French forces in the Arras area. The idea behind this operation was to render Amiens more secure by driving the Germans eastwards. Further, it was hoped that, if the attack could be pushed forward on a wide front, a sufficient gap would be made to enable the cavalry to advance on Cambrai and cut the Thionville-Lille railway and so unhinge the German communications. The preparations were methodical in the extreme, and little attempt was made to disguise them, in fact, it was impossible to do so. The surprise of this battle was to be an artillery one, not a bombardment, but a rolling barrage, under cover of which the infantry would slowly move forward from objective to objective. Machine-guns were increased in number, and the French infantry were partially equipped with an automatic rifle.

The preliminary bombardment was a prolonged one. On the British front it lasted for eight days, and no less than 2,000,000 shells were fired. On July 1, the attack was launched on a 25-miles front. The French gained some ground, and so did the British right, but the British left met with a serious check, and by the end of the first day our losses totalled no less than 40,000; the battle was, in fact, a tactical defeat. Nevertheless it was continued until November 18, and at terrific cost to all sides; it was not only a battle of attrition, but of mutual destruction. If ultimate success could be reached only by battles of this nature, then it was clear that the side which could put in the last 100,000 fresh men was going to win the war.

5. *The Tactics of Single Penetration.*

Both the battles of Verdun and the Somme aimed at effecting a single penetration by overwhelming artillery fire directed at one point in the entire front. I will now examine these tactics.

In slow methodical frontal attacks of penetration against an entrenched position, a battle salient is formed, and the understanding of the nature of this pocket is the key to all these operations. The main reasons for its formation are:

(i) That it is necessary to protect the flanks and rear of the attacking force.
(ii) That artillery protection on the flanks is limited by the arcs of fire of the guns.
(iii) That hostile weapon pressure on the flanks

tends, as the troops advance, to round off the attack.

(iv) That losses invariably tend to contraction towards the axis of the attack.

(v) That fear generally tends to induce men "to bunch" inwards, that is, away from the exposed flank.

(vi) That, as the centre is more securely protected by and against fire than the flanks, the advance here is more rapid than on the wings of the attack.

(vii) That, as the centre is freer from the enemy's fire than the flanks, its supply is safer, and, consequently, more rapid.

(viii) That, as the advance of the centre is generally along a line running at right angles to the original front, its movement is less complicated than those of the flanks.

These are the chief reasons, and from them may be established a practical theorem for battles of penetration, which can be tested by the measurement of actual battle salients, namely, that the flanking angles of a determined attack incline inwards at approximately 45 degrees. If, therefore, a penetration is to be effected, its eventual depth will bear a close relationship to the width of the original frontage attacked.

The question now arises, how wide, from flank to flank, should the final frontage be, for, if this width can be decided on, then the width of the initial frontage to be attacked can be gauged, and a rough estimate of the strength of the forces required to effect a penetration between these two frontages can be calculated.

The controlling factor in this calculation is the final frontage, which must be sufficiently wide to permit of a large force passing through the centre of the gap unaffected by hostile fire on its flanks. This gap must, therefore, be about 15 miles in width, and as this width will bear a definite ratio to the initial frontage, the width of the initial frontage may be arrived at by measuring the distance between these two frontages, multiplying it by two and adding this distance to the width of the front to be penetrated. Thus in diagram 1:

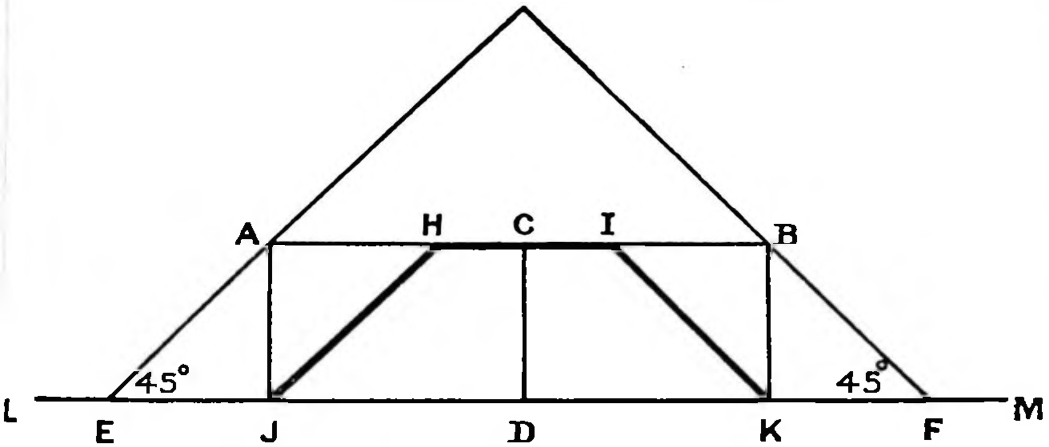


DIAGRAM I

If the width of the gap is A B and the distance between it and the base L M is C D, E F will equal A B plus 2C D, in this case 15 miles plus 2 × 5 miles, that is 25 miles, and the defiladed interior cone J H C I K will have a base of 15 miles and a truncated apex of 5 miles free from most projectiles.

The number of infantry divisions required to effect a penetration against a strongly entrenched enemy holding three defensive lines of a depth of five miles, may theoretically be worked out as follows:

There are three lines of trenches to be penetrated each of which will require a separate line of divisions. The distance between each of these lines is two and a half miles. An infantry division had at this date a battle front of about 1,500 yards in the initial attack, 2,000 in the secondary attack, and 3,000 in the tertiary. Consequently (*see* diagram 2), 29 divisions will be required to penetrate the 1st line, and 18 and 9 divisions to penetrate the 2nd and 3rd lines respectively. This gives us a total of 56 divisions.

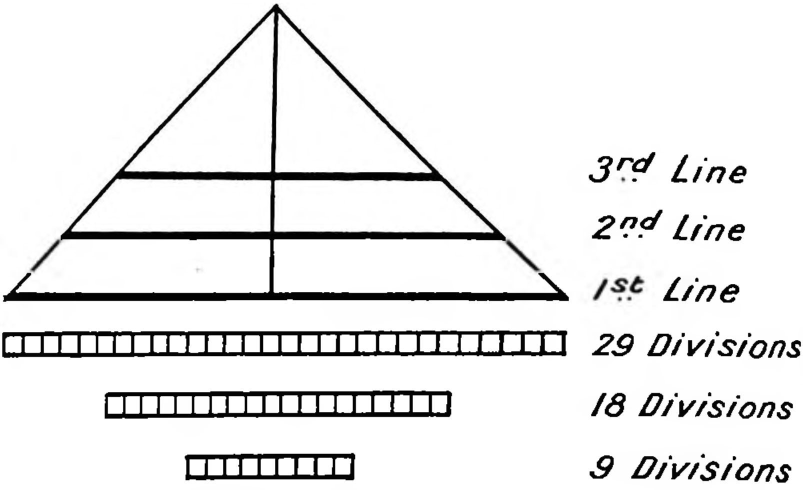


DIAGRAM 2

After the initial attack, 25 divisions can be withdrawn to refit, and after the secondary attack —14; this means that, once the penetration has been effected, 39 divisions will be in potential reserve, and the remaining 17 will be holding the sides and apex of the hollow truncated cone (*see* diagram 3). The area G, which has a base of 15 miles, is practically shell free, and forms the manœuvre ground for the forces which are to pass through the gap. As the 39 divisions will take at least seven days to refit, they cannot be employed to pursue the enemy or to develop one or both of the flanks created; therefore, besides the 56 divisions for the penetration, a field army of at least 21 divisions will be required, nine of these divisions to act as a general advanced guard to

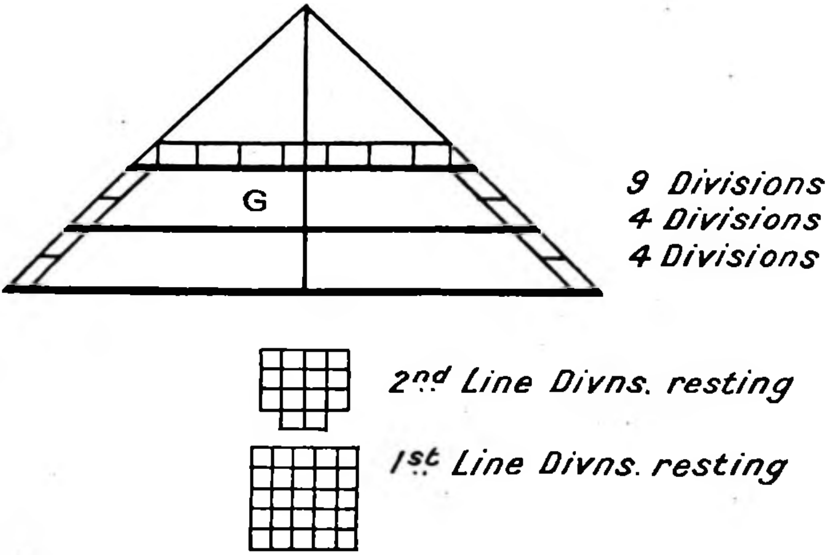


DIAGRAM 3

cover the approach of the remaining 12 which will act as a manœuvre mass (*see* diagram 4), supported by the 39 divisions once these have refitted. The total number of divisions required is, therefore, 77, or 1,200,000 men. The supply of this prodigious force in the restricted area obtainable is manifestly most difficult, if not impossible, consequently, the result is that an attack of penetration against a determined and well entrenched enemy is normally unsuccessful.

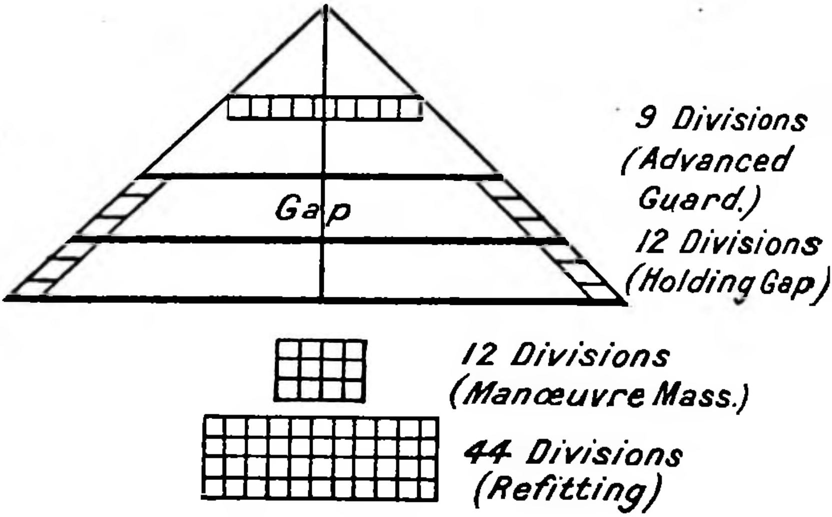


DIAGRAM 4

I have entered into this detail on purpose to show the immense difficulties of attacks of penetration. The depth to be penetrated I have taken as being five miles, but, in 1916, many trench systems were deeper than this, and every hundred yards added to the depth meant thousands of more men added to the penetrating force. Operations of single penetration with artillery and infantry were not practical against deep and well held entrenched zones.

6. *Tactical Theories at the end of* 1916.

The battles of Verdun and the Somme proved to the hilt General Pétain's theory of attrition. Decision was never reached, because, as the penetrating forces bored their way slowly through the enemy's defences, new trenches were constructed behind them, and the whole front, except for the actual battlefield, provided the enemy with reserves.

The initial attack had generally proved successful, not only because of the preponderance of the attacking artillery, but because it was possible to launch this attack as a surprise. Once this surprise had been accomplished, the battle, as a moving action, was over, and the attack became a pure siege operation.

In the main, the French considered that their theory of attack had proved itself effective, but that failure was due to an imperfect application of it. Objectives had become too limited, and the result was that the advance was slowed down to such an extent that the initiative passed over to the enemy in the form of counter-attacks. This resulted in the issue of the following instructions in December, 1916:

(i) All attacks must be made on as wide a frontage as possible, otherwise distant objectives cannot be captured.

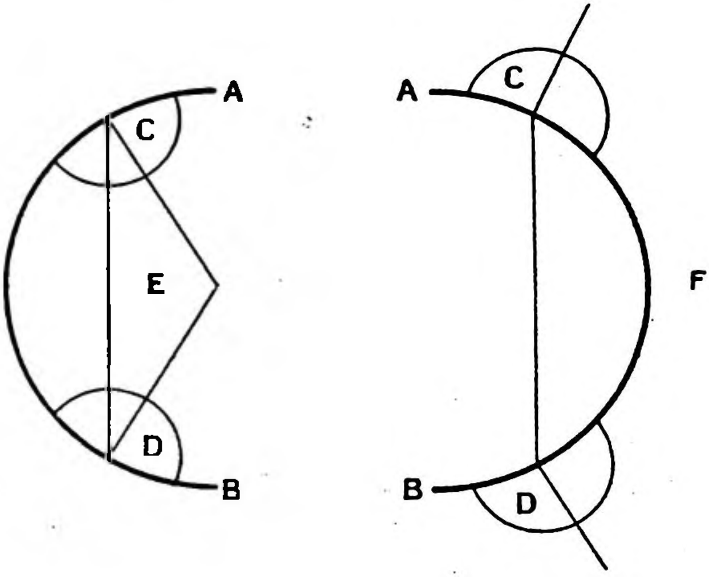
(ii) The object of the attack is the zone of the enemy's guns, consequently, artillery must be placed as close as possible to the attackers.
(iii) The attack will only suceed if each wave passes through the one in front of it without delay.
(iv) Full preparation must be made to push the exploiting forces rapidly forward.

The underlying idea was the same as in 1915, namely, " artillery conquers and infantry occupies," it was the occupation which these instructions attempted to speed up. Thus, more and more did it become apparent that the weak link in the attack was the infantry.

7. *The Tactics of Dual Penetration.*

Before I turn to the battles of 1917, I will examine the tactics of the dual penetration so as to render the spring operations of this year more intelligible. I have already pointed out the nature of the tactical salient Arras-Noyon-Reims, and that, in the autumn of 1915, a dual penetration was attempted by two simultaneous attacks, one from Artois and the other from Champagne. What does such a combined offensive entail? To answer this question we must return to our examination of battle salients.

Remembering what I have already written, the following still holds good, namely : if a penetration is to be effected, the salient created by the attack must be sufficiently extensive to prevent concentric fire being brought to bear on its central cone. But in a dual penetration we must add: if penetration is to be effected *between* two battle salients, then the axes of the two attacks must converge on the mean central line running at right angles to a line joining the centres of the two bases of operations (*see* diagrams 5 and 6).



DIAGRAMS 5 & 6

A glance at the diagrams will at once show that an enemy placed at E in diagram 5 is more precariously situated than one at F in diagram 6.

As I have shown that an attack of penetration against one sector of the enemy's front is most difficult, I will now consider the dual attack, that is, an attack against two closely related sectors of the enemy's front, made with a view to break the section which connects them. In such an attack, it is advantageous if a salient be chosen as the objective. For an operation of this nature three separate forces are required, as shown in diagram 7.[1] A attacks at D, not with a view to penetrate but to form a battle salient which will draw the enemy's reserves towards D. B attacks at E, to do likewise. Meanwhile a tactical penetration is being automatically effected in the area between the salients D and E, not only by the exhaustion of the enemy's reserve, which can reinforce this intermediary sector should it be attacked, but by a squeezing of this sector into so pronounced a salient that concentric fire will render it untenable. The enemy holding it will normally be forced to evacuate it, thereupon C,

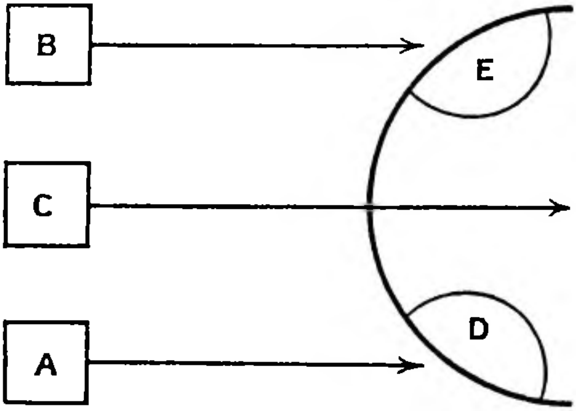


DIAGRAM 7

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[1] I arrived at this conclusion towards the end of 1915. See "The Principles of War as applied to the Campaigns of 1914-1915," in the *Journal of the Royal United Service Institution*, Feb. 1916.

following up his withdrawal, will effect a penetration under the protection of the two tactical bastions formed by A and B at D and E, which prevent concentric fire being delivered against C's flanks.

In the above example the controlling factor is the distance between the centres of the battle salients to be formed. Frequently this distance is considerable, and when this is the case a quadruple attack may become necessary. Thus, in diagram 8, suppose A G represents the enemy's

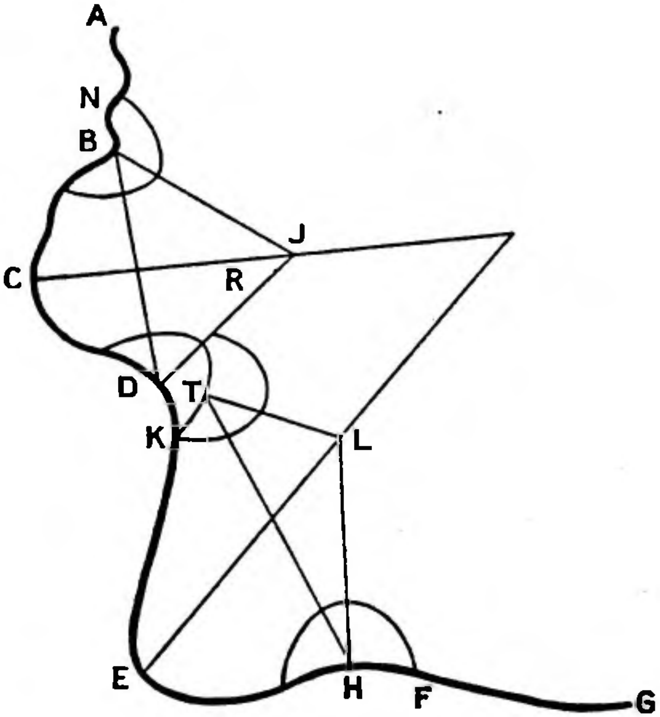

DIAGRAM 8

front, it is at once apparent, if a dual attack is to be made, that it should be directed against one of the salients A E G, K E F, or B C D. To cut off the first is difficult on account of the long intermediary sector between B and H. To cut off the second is dangerous, as an attack at K will jeopardise the attacker's left flank. To cut off the third is simple, and may be carried out on the lines already discussed. Suppose that this attack is successful, and that the enemy falls back to the line N R K, then the next series of attacks can be made from T and H, the penetration being effected along the line E L, which, if it succeeds, will force the enemy to fall back from N R and so create a gap from N to F.

8. *The Spring Offensive,* 1917.

The spring offensive of 1917 is an exceptionally interesting operation, for immense experience in the attack of trenches had by now been accumulated, and the supply of ammunition was rapidly becoming unlimited. The battles of Verdun and the Somme had been fought to break the line at single places, now an attempt was to be made to revert to the Artois-Champagne tactics, and, by hitting at the enemy in one locality, compel him to draw his troops away from another at which the main blow was to fall.

In the project of these operations the idea was to cut off the Arras-Noyon-Reims salient by two attacks; the first being delivered from Arras eastwards towards Valenciennes, and the second from

Soissons-Reims northwards towards Mézières. Seven-eighths of the German forces on the Western Front were occupying this salient, and not an inconsiderable portion of this mass the smaller salient—Arras-Gommecourt-Morval, created by the Allied advance during the battle of the Somme.

The plan of attack against the Arras sector had been considered shortly before the opening of the battle of the Somme, then it had been dropped only to be revived again in October, and, from this time on to April, the most elaborate preparations were made to meet it. Then, in February, 1917, the Germans constructed an immensely strong line of entrenchments running from Neuville Vitasse, a little to the south-east of Arras, *via* Quéant and St. Quentin to about Craonne, known to the Allies as the Hindenburg Line. The whole tactical situation was now altered, for, when in February, the Germans retired to this line, the lesser salient Arras-Gommecourt-Morval disappeared; the nose of the greater salient was rounded off, and the country between the old and new German front lines was left a wilderness with every village flattened and every road blown. To strengthen the Arras front, the Germans built a rear line from Quéant to Drocourt; this was not completed at the time of the battle.

The idea behind the British plan was to pierce the German front line from Vimy to Croisilles, pass a great mass of cavalry through the gap and force the Drocourt-Quéant line. Success depended on penetrating the Drocourt-Quéant line within forty-eight hours of the initial attack, for otherwise the Germans would once again be able to draw in their reserves and block the gap. To effect this surprise it was, in my opinion, essential that the initial bombardment should be short and violent, nevertheless, one of 15 days' duration was decided on, in which 2,700,000 shells were fired. Thus, the battle was lost days before the attack was launched, for these tactics rendered surprise impossible.

The battle opened on April 9, and under cover of a magnificent rolling barrage the infantry penetrated to Monchy le Preux a depth of some 7,000 yards; then the battle to all intents and purposes ended, for although it was continued till May 4, little further progress was made, and when the operation closed down it had cost 155,000 casualties.

The French attack, which was launched between Soissons and Reims on April 16, ended in a complete fiasco, in spite of the fact that to the artillery of the forces engaged were added 2,000 heavy guns and 1,500 trench pieces. The French attributed their failure to the dispersion of their artillery fire through selecting too many gun objectives; to the extensive use made by the Germans of wire on the reverse slopes of their positions, and to the total absence of surprise. This last reason was undoubtedly the most important, and as by now the German defensive zone was in many places ten miles deep, penetration by gun fire had virtually become impossible. the spade in fact had beaten the cannon.

Besides these reasons, neither we nor the French had grasped the true grand tactics of penetration. In this spring offensive, the two battlefields were no less than 80 miles apart as the crow flies, consequently they were too far distant to affect the intermediary sector. The Allies, as far as I am aware, had not grasped the crucial fact that the only way to effect a penetration was to force the retirement of the garrisons of this intermediary sector by two powerful flanking attacks. This was not attempted, instead—two *separate* acts of penetration were carried out simultaneously.

9. *The last of the Great Artillery Battles.*

In spite of uniform failure in all attempts to penetrate the enemy's defensive zone, G.H.Q. determined to carry out two more great operations, the first was the capture of the Messines ridge, which was to constitute a stepping stone to the second: the penetration of the Ypres salient with a view to capturing the coast line and the inland submarine base at Bruges.

The first of these operations, the capture of the Messines-Wytschaete ridge, constituted a purely limited objective. The battle was begun on June 7, and ended in a great success, because the operation was a limited one. The second, which opened on July 31, and which dragged on to November 10, was from start to finish a colossal failure, and for the following reasons: First, Flanders is far more suited to defensive than to offensive operations; I have already called it a bastion; secondly, if the elaborate system of drainage which covers this entire area is rendered inoperative, the whole country rapidly reverts to its natural condition of a swamp. If troops were to advance over this country, the one essential was that as little damage as possible should be done to the surface of the ground. What happened? We assembled at Ypres the largest force of artillery ever seen in British history, the gunner personnel numbered no less than 120,000; we dumped at Ypres 321 400-ton train loads of ammunition, and fired this off in a preliminary bombardment which lasted for 19 days. In this bombardment were fired 4,283,000 shells weighing 107,000 tons. The whole surface of the battlefield was torn up, all drains were destroyed as well as roads, and an all but uncrossable swamp was created in which the infantry wallowed for nearly five months. The ground gained was approximately 45 square miles, and each square mile cost us 8,222 casualties.

10. *Tactical Theory at the end of* 1917.

General Pétain, who, in May, had been promoted to the supreme command of the French Armies, had noted the great success of powerful and well mounted attacks on limited objectives, such as the battle of Messines, on June 7, and of Malmaison, on October 23; he decided, therefore, for the time being to abandon any idea of gaining a decision, and in place to carry out a number of limited attacks on objectives which were vital to the Germans; each attack to be delivered as a surprise, and to be closed down directly surprise began to wane.

On October 31 and December 20, instructions were issued to the French Army on offensive and defensive actions respectively. In the first of these the theory outlined was as follows:

The entire front is to be divided into defensive and offensive sectors. The object is still to penetrate the enemy's front, but not at one selected point, but by so shaking the whole front that sooner or later one section of it will become so weak as to permit a successful frontal attack being made against it. This shaking process was to be effected by a series of violent yet limited attacks, or local punches, which would, by degrees, exhaust the enemy's endurance. Troops were to be rapidly concentrated, and attacks were to be rapidly mounted, delivered and broken off. The essential conditions were:

(i) Minute preparation.
(ii) Superiority of force at the point of attack.
(iii) Surprise.
(iv) Rapidity of attack.

Roads were to be built, railways laid down, depôts and dumps formed all along the front, and special attacking forces trained which would move from one place to another, and find all ready for the punches they were to deliver. In these arrangements we see a return to the idea of mobility, which had been abandoned for so long; also to the idea of surprise, which had been obscured by shell bludgeoning, and to the idea of command, which, during the great artillery battles, had been abdicated, for the Quartermaster General, with his train loads of shells, had entirely replaced in importance the Commander-in-Chief. These instructions were excellent, but they arrived too late, for two new weapons had crept over the horizon of the war, which were destined not only to introduce a new period, but a new epoch.

11. *General von Hutier's Attack at Riga.*

Whilst the Third Battle of Ypres was in progress, a remarkable attack was carried out by the Germans in the neighbourhood of Riga, which largely influenced the German grand tactics of 1918. General von Hutier selected a small sector of the Russian line, some 4,600 yards in width, he massed against it a strong force of guns, one to every eight yards of front, and, on September 3, inundated it with gas shells, and then attacked. The whole operation was over in a few hours, and the success was complete, the reason being that he based his tactics not on the destruction of wire and trenches, but on the destruction of the Russian troops—infantry and gunners—opposed to him. This seems a very simple and common-sense idea, yet it was one which, on the Western Front, had been in the main lost sight of for three years. For three long and terrible years the Allied Armies had been hallucinated by material destruction. I will now turn to the second novel weapon.

12. *The Battle of Cambrai.*

On August 8, 1917, in order to relieve the pressure in the Ypres area, the Tank Corps suggested that a tank and dismounted cavalry raid should be carried out south of Cambrai, between the Canal du Nord and the St. Quentin Canal. This area was chosen because the operation proposed was of a limited nature, and these two canals would automatically confine its margins. The ground was *not* chosen to fight a decisive battle on.

On October 20, G.H.Q. decided that the Third Army should prepare a tank and infantry attack south of Cambrai. The area selected was the same as suggested by the Tank Corps in August, but the object of the attack was now to penetrate the German trenches on a front of 13,000 yards, seize Cambrai, round up the Germans south of the river Sensée and west of the Canal du Nord, and exploit the success towards Valenciennes. The battle was, consequently, to be a *decisive* operation, and for such an operation two conditions were required: first, open unobstructed flanks so that the tanks could move outwards and rapidly widen the point penetrated, and secondly, that adequate reserves and supplies were assembled to move through the gap once it was created.

It will be remembered that the sides of battle salients normally slope inwards at an angle of about 45 degrees. Above, I gave reasons for this; but with tanks all the difficulties mentioned can be overcome, and in place of the two defensive flanks, so necessary to protect the central cone of an artillery and infantry attack, two *offensive* flanks can be created, which as they are pushed outwards will add more and more room to manœuvre in in the centre.

The canals flanking the battlefield of Cambrai prohibited this extension outwards, further, as the St. Quentin Canal took a sharp bend westwards at Crèvecoeur, unless tanks could cross the canal at Masnières, the battle front would be narrowed down to 8,000 yards, that is, from Marcoing to the Canal du Nord.

Because of these limitations, the Tank Corps suggested that two-thirds of the tanks should be concentrated *on the left of the line Marcoing-Villers-Plouich,* and organised into two echelons; the first to break through the Hindenburg Line on the 20th, and the second to be held in reserve and pushed through the gap on the 21st. This suggestion was not listened to, and in place all the fighting machines, 378 in number, were distributed in approximately equal strength along the front. This most faulty distribution virtually limited the attack to a one day's operation.

The attack on November 20, was a remarkable local success, a penetration of 10,000 yards was effected, without any preliminary bombardment.

At Ypres, 120,000 gunners entirely failed to accomplish what in this battle was done by 4,000 tank soldiers, and on the 20th, 8,000 prisoners and 100 guns were captured, and our own casualties were about 5,000 and not 40,000 as on the first day of the battle of the Somme.

The success was, however, short lived, and for the following reasons:

(i) No reserve of tanks existed for the second day's operations.
(ii) Totally inadequate reserves were at hand to exploit.
(iii) Cambrai, being a great railway centre, enabled the Germans rapidly to assemble reinforcements.
(iv) The two canals checkmated any attempt to move the tanks outwards and so secure the battle flanks by offensive expansion.

Under cover of the St. Quentin Canal, the Germans assembled large forces, and, on November 30, launched a counter-attack which regained much of the ground they had lost.

13. *The Lessons of Riga and Cambrai.*

The secret of the successes at Riga and Cambrai was surprise. This lesson was appreciated by the Germans and the French, but only partially so by ourselves. In both these battles, the front of attack had been kept a close secret. At Riga, von Hutier had selected a wooded region which prevented the Russians ascertaining what he was doing; at Cambrai all preliminary movements took place at night, and the foggy weather greatly assisted the secret assembly of troops.

The main lessons learnt, or which should have been learnt, from these two remarkable operations were:

(i) To maintain secrecy, extensive use must be made of camouflage; no movements must take place by day and any increase in fires must be avoided.

(ii) To attain surprise, no preliminary registration of guns or bombardment must be allowed, and no new trenches must be dug.

(iii) To prevent leakage of information, the troops who are to carry out the attack must be kept well in rear until the attack is imminent, and they must be trained for the operation.

(iv) To obtain continuity of movement, strong reserves must be ready in hand to replace the initial attackers directly they are exhausted.

Thus, at length, thanks to two new inventions—the gas shell and the tank—surprise as the grand tactical act of battle was reinstated. I will now trace its evolution during 1918.

14. *The German Spring Offensive,* 1918.

The German spring offensive, which opened on March 21, was based on the tactics made use of by von Hutier at Riga. The front selected ran from about Lens to La Fère, and was some 74 miles in extent. Sixty-two divisions were to be employed on this front, which, except for a few miles, was held by the Third and Fifth British Armies, whose respective strengths were 17 and 14 divisions, exactly half the attacking force. Though the Germans intended to attack the whole of this front, the main effort was to be made north of St. Quentin at the point of junction between the British right and and French left. In this area was assembled an enormous mass of guns, one to every eight yards of front, and on March 21, after a short but violent bombardment of gas shells, the infantry assault was launched. By the evening of March 22 a penetration of about 10 miles was effected, and by the 31st Montdidier was reached.

The initial success had been great, but the penetration which was effected was only 38 miles, or approximately half the original base of 74 miles. The failure of the battle was due to well ascertainable causes, the two most important being the narrowness of the front when compared to the depth of penetration required in order to obtain a decisive result, and the insuperable difficulty of keeping an advancing front of many divisions supplied. The German front of attack, as I have said, was about 74 miles, and by April 4 the depth of the penetration effected was some 38 miles. Consequently, if it was necessary to reach Abbeville, some 60 miles from the original German front, in order to effect a separation of the British and French forces, the initial front of attack should have been at least 120 miles in width. Though the German forces were insufficient to attack on such a frontage, had they been sufficient, the second factor, namely, difficulty of supply, would in all probability have wrecked their plan. We thus see that any attempt on the part of the Germans to win the war by an immense frontal attack before the Americans could develop their strength, was, as long as the Allies resisted stubbornly, virtually an impossible operation. This by April 4 was realised by the German Higher Command, for the battle on the Amiens-Noyon front was closed down save for minor operations south of La Fère, and other fronts of attack were sought, namely, those west of Lille, south of Laon, and north of Compiègne, which were attacked respectively on April 9, May 27 and June 9.

In the attacks of April 9 and May 27 great quantities of gas shells were again used, and the fronts between Festubert and Fleurbaix, and Soissons and Reims were rapidly overrun; but once the depth of penetration had roughly equalled half the length of the base attack they died out.

From the grand tactical point of view these three battles were a failure, the reason being that, though penetration by surprise could now be effected against any weak point in the enemy's line, movement could not be maintained because supply could not keep pace with the attack, and the attackers themselves could not be reinforced sufficiently rapidly. This being so, and it undoubtedly was so, it is interesting to find that this point was entirely overlooked. Surprise had been so long obscured by shell-bludgeoning that, now it was rediscovered, all sides were so pleased that they could not refrain from repeating it; it was a new toy, just as the rolling barrage had been.

The Germans had effected three of the most extensive advances of the war by means of surprise; therefore the secret was surprise; but it was overlooked that, whilst this was so, each of these great attacks had "petered out" because they could not be supplied. Surprise, it was forgotten, is only a tactical means towards victory, it is not an end in itself, but a means towards an end. The secret of penetration was now common property, but the secret of exploiting a penetration was still a sealed letter, and only at the very end of the war was any attempt made to break the seals.

In July, another set of instructions were issued to the French Army, and in these we read:

Attacks must be prepared with "le maximum de secret" and launched with "le maximum de surprise," and as often as possible without artillery preparation but by tanks. Exploitation will be immediate and distant in order "to ensure continuity of effort and to prevent the enemy pulling himself together."

All this is excellent advice, but surprise alone will not attain it, surprise will not fill men's stomachs with food, it will not rest their legs, or replenish their empty pouches and their gun limbers. Penetration requires surprise; exploitation, or pursuit, requires continuity of movement. During 1915, 1916, and most of 1917, the

Commander-in-Chief had been replaced by the Quartermaster General; by the middle of 1918, the Commander-in-Chief, in the person of General Foch, had come back to his own, and the Quartermaster General was forgotten. Yet to answer the supreme tactical question of the war—what happens when the gap is formed?—is far more a Quartermaster General's problem than anyone else's; this was not understood in July, 1918, it was overlooked just as surprise had been.

15. *The Franco-British Summer Offensives.*

In examining the Franco-British summer and autumn offensives, the reader should, for a moment, turn back to the tactics of the dual penetration, and then examine diagram 9, which shows a rough outline of the Western Front from Ypres to Reims. This front is made up of three salients formed by the three German attacks—the Merville salient, the Amiens salient, and the Château-Thierry salient. As regards the Merville salient, though an operation was contemplated against it, it was abandoned as the country was not suitable for a tank offensive. As regards the Amiens salient, it offered a superb opportunity of effecting a dual penetration on the lines I have outlined: one force striking from Amiens and the Somme eastwards, and another a little west of Soissons northwards, the axes of these attacks intersecting at Peronne. The result of such a dual attack, carried out with tanks, would cause

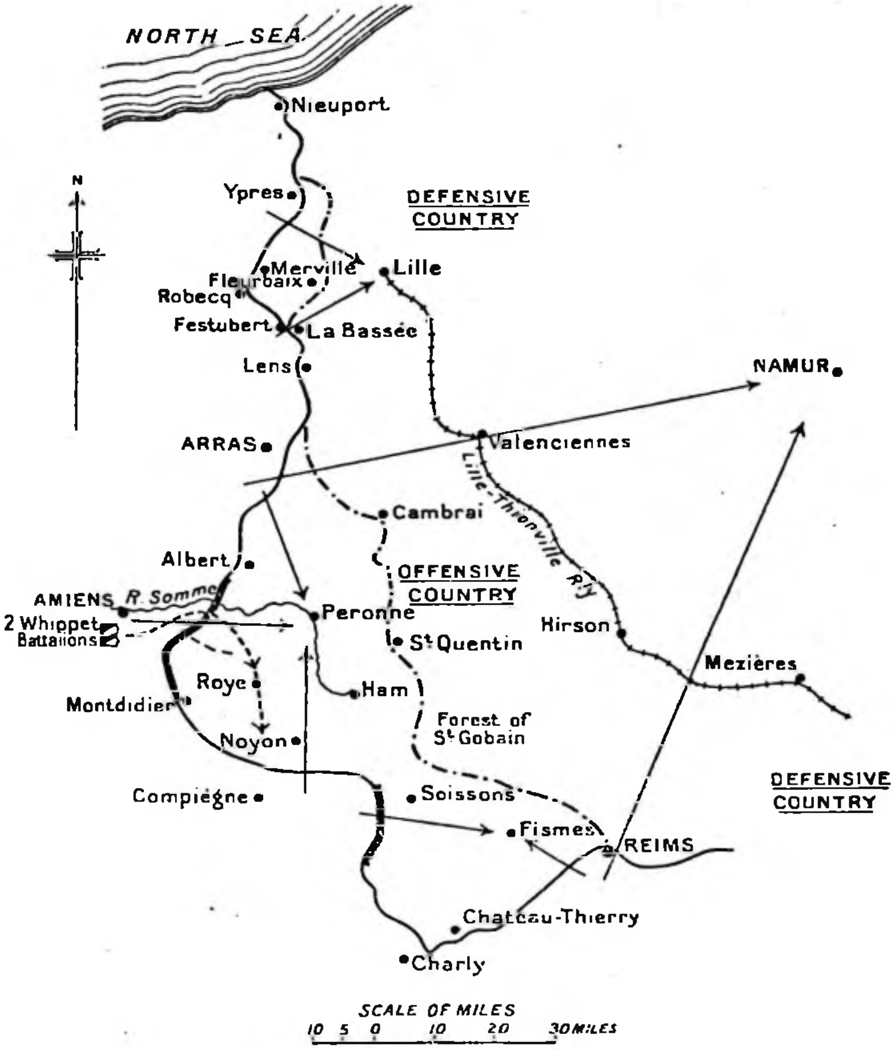
NORTH SEA
Nieuport
N
Ypres
DEFENSIVE COUNTRY
Merville
Fleurbaix
Robecq
Lille
Festubert
La Bassée
Lens
NAMUR
ARRAS
Valenciennes
Lille-Thionville R^y
Cambrai
Albert
OFFENSIVE COUNTRY
AMIENS
R. Somme
2 Whippet Battalions
Peronne
Hirson
S^t Quentin
Mezieres
Roye
Ham
Montdidier
Forest of S^t Gobain
Noyon
DEFENSIVE COUNTRY
Compiègne
Soissons
Fismes
REIMS
Chateau-Thierry
Charly
SCALE OF MILES
10 5 0 10 20 30 MILES

DIAGRAM 9

the whole front from the Somme to Soissons to cave in, and would effect a penetration of no less than 45 miles. As regards the Reims salient, as enormous numbers of Germans were occupying it, a dual attack, one from west of Soissons, and the other from Reims converging on Fismes was likely to result in a veritable *débâcle.* This attack was also considered, and had there been sufficient tanks in the French and British Armies, quite possibly two attacks would have been attempted simultaneously, one against the Amiens salient, and one against that of Château-Thierry. Had these attacks succeeded, a gap of 80 miles would have been made in the German front.

While these various plans were being considered at the Allied Headquarters, on July 15, the Germans launched their last offensive in Champagne. The French having reverted to the pre-war idea of the outpost line, the German attackers fell through a paper partition, and were met, on the 18th, by a formidable counter-attack delivered against the western flank of the salient and preceded by 225 Renault tanks. Thus opened the Second Battle of the Marne, and it was continued to August 7.

The result was that the Château-Thierry salient vanished, and that the French tank units were too exhausted to withdraw, refit and re-engage against the Amiens salient, against the apex of which an attack was delivered on August 8. Into the nature of this attack I will now enquire.

The ideal operation would have been to deliver one attack from Arras south-eastwards, and the other from a little east of Compiègne northwards, the axes of which would converge on Peronne; but the main reasons which rendered this operation a difficult one were: the valley of the river Somme cut the salient in half; the old Somme battlefield was bad offensive country, being furrowed by hundreds of old trenches; besides communications across it were very few and bad; lastly, the French had temporarily exhausted their tank units. The next most promising operation was a dual attack from Amiens eastwards and from Compiègne northwards. This may have been considered, but, if so, it was laid aside and replaced by a Franco-British attack extending from a little north of the Somme to Montdidier.

The British attack was first of all looked upon as a local operation, the objective being limited to the recapture of the old Amiens defence line. At a Conference held at the Fourth British Army Headquarters on July 21, it was decided, however, to extend it to the Somme from Peronne southwards. The tactics to be employed were to be based on tanks: nine battalions were to lead the attack, one was to be kept in reserve and two whippet battalions were allotted to the cavalry who were to carry out the exploitation.

The Tank Corps representative attending this conference considered the tank reserves inadequate, and suggested that as the French First Army, operating on the right of the British Fourth Army, had no tanks, the two battalions of whippet tanks

(96 machines in all) should not be tied down to operate with the cavalry, but should independently move forward directly a gap was created, and by advancing on Roye (*see* diagram 9), attack the rear of the Germans facing the French First Army. This suggestion, however, could not be met, consequently the attack became a frontal one.

The result of the great battle, on August 8, is well known. The Germans were decisively defeated, and Ludendorff christened this day "the black day of the German Army." On the 11th, the British offensive ended, and was re-opened north of the river Somme on the 21st. From now onwards attack followed attack, but all were of short duration, and there was no pursuit because advancing troops could not be adequately supplied. In all these battles the same difficulty confronted the Allies, which, earlier in the year, confronted the Germans, namely, the maintenance of battle energy by supply and reinforcements. The war ended before this problem was solved, but, had it continued for another six or twelve months, I fancy a solution would have been found as this problem was being carefully considered.

In this last great campaign of the war, what do we see from the grand tactical point of view? We see, amongst many things, three outstanding factors: ground, grand tactical formation and the influence of communications. I will briefly consider these. It will be remembered that the zone of the Franco-Belgian frontier can be divided into two defensive areas, or bastions—Flanders and the Ardennes, and that between these lies the good offensive area of Hainault, which extends south-westwards towards Paris. Where, in 1914, did the Germans advance most rapidly? In this offensive area, and because they did so, when they were halted, the grand tactical formation of the front became a salient Arras-Noyon-Reims, flanked by the two bastions. In rear of this salient ran the great railway from Thionville to Lille.

In March, 1918, where did the Germans attack? They attacked in this same good offensive area. And, when the French and British counter-attacked, what area of operations did they select? This very one. What points did they strike at? Valenciennes and Mézières, and when they reached them the great Thionville-Lille railway was cut and the Germans asked for an armistice.

What does this teach us grand-tactically? That the Allied offensive against the bastions—Ypres and Verdun, were misjudged; that there was but one area in this part of the Western Front in which offensives should only have been attempted. namely, the triangle of good offensive country between Arras, Reims and Namur (*see* diagram 9), and that consequently, all offensive operations from start to finish should have been restricted to this area; the tactical operation being the dual penetration from Arras and Reims, and the strategical objective being the cutting of the Thion-ville-Lille railway at Valenciennes and Mézières. Could not this have been appreciated in November, 1914?

16. *The Project for* 1919.

To round off the development of the tactics of penetration on the Western Front, it is necessary to consider what was intended had the war been prolonged into 1919.

The problem was no longer how to break the enemy's front, the tank had solved this difficulty, but, instead, how to maintain continuity of forward movement, in other words, how to effect an unbroken pursuit. As long as the enemy was only punched back, and after each blow was given time to recover, he could always find time to destroy communications—roads and railways, before he withdrew. Without roads and railways the pursuit of a determined enemy was not possible. Two suggestions were put forward, the first on May 24, 1918,[1] and the second a few weeks later.

The first was, by means of fast moving tanks to strike at the enemy's system of command and supply, as well as drive a hole through his front. This operation was to be carried out as follows:

(i) A force of fast moving machines, under cover of darkness or smoke, was to rush through the enemy's front and attack his divisional corps and army headquarters as well as his railheads and supply centres.

(ii) Simultaneously the normal tank, artillery and infantry attack was to be made on the troops in front of these headquarters.

It was considered that if these two attacks, one on the enemy's brain and stomach, and one on his body, could be successfully carried out on a frontage of 50 miles or more, such demoralisation and disorganisation would result that the enemy would not be able to effect an orderly retreat, and that, consequently, communications would be left intact.

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[1] For full account see Chapter IV.

The second suggestion was purely an administrative one—the supply of the pursuing force, which it was maintained could be solved by means of cross-country supply tractors.

The upshot of these suggestions were that orders were placed for 6,000 to 8,000 tanks and 10,000 supply tractors, the bulk of which would have been ready by the early summer of 1919.

As regards the first suggestion, it is interesting to note that a somewhat similar operation was carried out before the war ended. At the battle of Megiddo, which began on September 19, once the British guns had blown a hole in the Turkish line, large forces of cavalry were passed through. These, falling on the Turkish headquarters and communications, created such disorder and demoralisation that the whole Turkish front fell to pieces, and within a fortnight Damascus was occupied.

17. *Conclusions.*

Looking back on the tactics of the Great War and the tactical doctrines which were held by all armies before its outbreak, the lack of coincidence between the two is not only remarkable, but instructive. Since 1871 the great military nations of Europe had been engaged in studying the past to the exclusion of the future, consequently, the conditions in which the next war was to be fought were not grasped, consequently, all sides were surprised, not so much by each other's craft as by their own lack of foresight. If this were not bad enough, when towards the end of 1914 the war had disclosed its static nature, so little was understood of the science and art of war that even then, when it was obvious to all that penetration must be the prelude to the reinstatement of mobility, seldom do we find any one of the General Staffs attempting to make use of existing conditions, especially topographical ones, to assist in breaking the enemy's front. As I have pointed out, the triangle of country lying roughly between Namur, Arras and Reims was the only area in which penetration could be effected by offensive action with any hope of economy. Further, it was hopeless even in this area to attempt penetration at any one point or even at any two points unless they were sufficiently close together to influence detrimentally the area in between them. It was never grasped, so far as I am aware, that the point of penetration was not to be sought at the point of attack, but between two converging points of attack. It was never understood that if a line 400 miles long was to be broken, the front of attack must be at least 100 miles, and that the decisive attack should only be launched after the enemy's reserves had been exhausted. It was not realised that troops did not exist in sufficient numbers for such an extended attack, and even if they had they could not have been supplied. Lastly, the obsession of method, of numbers and of brute force prohibited surprise, the true forerunner of victory.

The possibility of carrying out an effective dual attack of penetration was, I maintain, a feasible operation in 1915, for though shell shortage existed, trench systems were still shallow. With armies as then organised, it was, I maintain, more feasible to do so than with the armies which existed in 1916, and most of 1917. It was not lack of fighting force which created the stalemate, but lack of knowing how to apply it correctly. Had this not been so there would have been no need to have carried the war to Gallipoli, to Mesopotamia, to Palestine and Salonika, all impossible decisive theatres. Lack of military imagination dispersed our fighting force, at a time when sanity demanded the concentration of every man and gun on the Arras-Reims front.

Later on we come to Riga and Cambrai, true battles of penetration based on surprise. Do we find wisdom resulting from them? No, only another obsession, namely, penetration itself—the tool is mistaken for the hand. If I am wrong, why then the gigantic single attacks of 1918? The German offensives were single, one following the other, and each aimed at a weak point. The French and British attacks are single; the value of salients is not understood, neither is the problem of supplying a moving army understood. Yet lethal gas and the tank were weapons pre-eminently suited to the dual attack, since gas could create defensive flanks by rendering areas uncrossable, and tanks could form offensive flanks and strike at the rear of the enemy, the enemy between the two points attacked. Have we learnt this lesson yet? I much doubt it. Have we learnt, that the decisive point of attack is the rear of the enemy's army, and that to hit this rear we want two forces, just as a boxer wants two fists; that all attacks should, when possible, be dual in nature, since it is more difficult then to gauge which force is going to hit out decisively. A boxer watches his adversary's fists, and it is more difficult to watch two fists than one fist, because whilst the right one is being watched the left may suddenly hit out. Do we understand this problem? If we do not, then the supreme tactical lesson of the war remains unlearnt, whether we intend to penetrate, envelope, or hit in rear. Two fists, a body in reserve, and one brain, such is the tactical organisation which the solution of this problem demands.

CHAPTER IV.

STRATEGICAL PARALYSIS AS THE OBJECT OF THE DECISIVE ATTACK.(1)

In March, 1918, it became apparent to me that there were two main causes for the British defeat. The first, which was obvious to all, was the overwhelming strength of the German attack; the second, which was not so obvious, was the loss of control by the British higher command. For three years on the Western Front all attacks and withdrawals had been methodical in the extreme. When the crash came, those who had depended on method suddenly found chaos in place of it, and through lack in the technique of dealing with chaotic situations they lost control. The dependence of an army on the will of its higher command was so accentuated by the operations of March and April, 1918, and our loss of man-power was so considerable, that in May I worked out the plan elaborated in this chapter, the underlying idea of which was the defeat of the German Armies through the paralysation of their higher command. This plan was accepted by Sir Henry Wilson, then C.I.G.S., and also by Marshal Foch, and from it was worked out a project for the 1919 Allied Spring Offensive, had the war continued. The present chapter, though a slightly condensed edition of the original paper, has in no way been altered in idea.

1. *The Nature of Surprise.*

THE strategical object of war is the destruction of the enemy's fighting strength. Though, generally in the past, this has been accomplished by pitched battles, in which many casualties have been inflicted and sustained, it is dangerous to infer from this that such must always be the case, for even in the past not a few battles have been won by surprise rather than by force of arms, and if a battle can be won without suffering loss,

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[1] *Weekly Tank Notes,* 31st May and 7th June, 1919.

surely this is the most economical, if not the most traditional, way of gaining the strategical object.

Surprise may be viewed under two main headings—doing something the enemy does not expect, or doing something the enemy is unprepared for even if he does expect it. If this latter state of surprise can be attained, the whole organisation of the attack will become as simple as an individual contest in the open between a man armed with a rifle and a man armed with a club; the latter is doomed even before the former has fired a shot.

2. *The Anatomy of Battle.*

In order to make certain of his antagonist, and economize muscular and explosive energy, the rifleman aims at his opponent's head or heart, in other words, he understands the anatomy of his victim, did he not do so he might shoot him through the calf of the leg, and the club-man, feigning death, might induce the rifleman to approach so close to him as to permit of an opportunity arising of using his club as a weapon of surprise under conditions which render it as effective as the rifle.

Throughout the history of warfare, from the earliest days to the present, innumerable cases of "calf-wounding" of the opposing army have occurred, with the result that the victor himself has frequently been mauled out of recognition. Such victories are purely Pyrrhic, and the generals who gain them frequently become of greater danger to their own side than those whom they have so expensively beaten. A victory, unless it can declare a dividend, is a bad investment. A card player who wins a game but loses on points is not a popular partner if he makes a habit of such play, and by the end of the evening has won a series of rubbers and lost most of his own and his partner's money; his opponents, taking the cash, will be quite willing to hand him the laurels.

War, all said and done, is mainly a matter of "human points," and though winning the game is the object, not one more point than necessary should be lost in the tactical engagements which go to so doing. To win a game we must understand its rules, so also with battle, and to understand the anatomy of battle is the first duty of every tactical commander.

Analyse this question:

Two opposing forces are deployed according to the power of their weapons and the formation of the ground. Fire is opened concentrically round the bayonet; that is to say, every weapon of longer range helps forward the weapon of shorter range.

What now is the tactical object?

To wear down the enemy's fighting strength, and by forcing him to use up his reserves to deny him the power of organizing and re-organizing this strength. In other words, to make him put all his counters in the pool, and so prevent him raising the stake.

This process of forcing him to part with "human capital" is usually arrived at by various grand tactical acts, the most important of which are known as attrition, penetration and envelopment.

3. *The Fixing of the Decisive Point.*

Napoleon had a saying: "First I engage, then I look, lastly I hit," in other words, he played for an opening, and only when one offered itself to him did he attempt to deliver a knock-out blow. The decisive point of attack, therefore, is that spot, which, if struck, will place the striker at the greatest advantage in order to defeat his opponent.

Where then is the decisive point?

Frederick considered it to be a flank; Napoleon did not know, favouring sometimes a flank, sometimes a central attack; consequently, nearly every text book on war since written states that the decisive point "depends on circumstances," and generally favours envelopment. Before this war most military schoolmen put odds on envelopment, though the back of a visiting card would have provided sufficient space whereon to prove that penetration was going to be the primary tactical operation of the next war.

In the second century a very noted physician was born, called Galen, and in the sixteenth another named Paracelsus Bombastes, but no medical student would to-day obtain his degree if he did not know more than these eminent and worldrenowned doctors. So with Frederick and Napoleon, though, had we lived in their days, we should not have been worthy to fasten their shoes; to-day, unless we know more of the art of war than they did, we are not worthy to command men.

Though there is little wrong with Frederick and Napoleon, there must be something very gravely wrong with the modern military schoolmen for considering that the decisive point depends on circumstances, unless this is read as meaning that everything in the world depends on something else, which is as thoroughly platitudinous as it is completely unilluminating.

What are the circumstances?

The circumstances appear to be that the schoolmen have not gauged that an army has a brain as well as a body. They apparently do not understand the difference between a shot through the head and bullet through the calf. They have accepted dogmas as gospel because Frederick did this and Napoleon did that. What were the implements of these great generals? The flint lock and the 12-pounder. Should we continue to think of war in terms of the blunderbuss? Does a Harley Street specialist think of medicine in terms of "Dragon's Blood" and "Grated Unicorn's Horn"? If an army has a brain why not lay it down in black and white that "The decisive point of attack is the brain of the opposing army," there is nothing to be ashamed of even in an army possessing such an organ.

Let us examine this question.

4. *The Anatomy of an Army.*

Every organisation has one great anatomical prototype—the body of man. When a boxer fights another he tries to get a left or right on the side of his opponent's jaw. Why? Not to break the jaw, but to *derange* the brain; because, more than any other organ the brain controls the body.

Let us now compare an army to the human body.

The commander and his immediate staff are the brains, the subordinate staffs and intelligence organisation are the nerves; the means of fighting and movement of the army are the muscles; and the organization for supply, the stomach and blood vessels.

The brain controls the whole body, nevertheless, the prevailing idea in tactics is brute force applied by weapons to the enemy's battle-body. Batter the enemy's muscles blue and black and get battered blue and black in return, until eventually one side or the other ends by being rendered unconscious through physical exhaustion, and then, only when they have ceased to function, will an attack on the brains be carried out.

Why not strike straight at the head?

Because it is protected by arms, the fighting troops of the army, rifles, cannon and sabres; because the whole conception of present day fighting is based on hand-weapons as distinct from machine-weapons, it is pre-mechanical, it is muscular. It may be Frederician or Napoleonic, but it is not twentieth century.

No man to-day if he wished to protect his house against burglars would go through a course of archery, or study how to couch the Sarissa, or swing the Lombardy Balls, he would go to a gunsmith and buy a pocket pistol, because it would cost him less money and trouble, and would prove much more effective.

To-day, the pocket pistol is the tank, and its method of employment, in order to reduce the enemy to a state of strategical paralysis, demands a brief appreciation of the effect of tanks on tactics and strategy generally. Once this is mastered it is not difficult to forecast what the doubling, trebling and quadruplicating of the speed and radius of action of the present day machines will mean to the art of war in the future.

5. *The Effect of Tanks on Land Tactics.*

Tactics, or the art of moving armed men on the battlefield, change directly in accordance with the nature of the weapons themselves, and the mobility of the means of transport. Each new or improved weapon or method of movement demands a corresponding change in the art of war.

To-day the introduction of the tank on the battlefield entirely revolutionises this art in that:

(i) It increases mobility by replacing muscular power by mechanical power.

(ii) It increases security by negativing the effect of bullets through the feasibility of carrying armour plate.

(iii) It increases offensive power by relieving the man from carrying his weapons, and the horse from dragging them, and by multiplying the destructive power of the weapons themselves by increasing their supply of ammunition.

In other words, petrol enables an army to obtain a greater effect from its weapons in a given time with less loss to itself than one which relies for its motor force on muscular energy. Whilst securing a man dynamically it enables him to fight statically.[1] Consequently it superimposes naval tactics on land tactics, that is, it enables men to discharge their weapons from a moving platform protected by a fixed shield.

6. *The Effect of Tanks on Land Strategy.*

The net-work upon which strategy is woven is the system of communications which exists in a theatre of war. Hitherto this system has consisted of roads, railways, rivers and canals. To-day, the introduction of a cross-country petrol-driven machine—tank or tractor—has expanded this system to include at least 75 per cent. of the entire terrain of a normal theatre of war over and above communications as we at present know them. The possibility to-day of maintaining supply and moving weapons and munitions over the open, irrespective of roads, and without the limiting factor of animal endurance, introduces an entirely new problem in the history of war. At the present moment he who grasps the full meaning of this change, namely, that the earth has now become as easily traversable as the sea, multiplies his chances of victory to an almost unlimited degree.

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[1] Hitherto the two great difficulties in the minor tactics of the attack have been:—

(i) How to harmonize movement and fire, the riflemen not being able to move whilst firing, or to fire whilst moving. To-day by placing him within a petrol driven and bullet-proof car, he is enabled to concentrate the whole of his muscular energy on the manipulation of his weapons whilst simultaneously being moved forward by mechanical means.

(ii) How to harmonize movement and security, the rifleman himself not being able even to cover his own advance by fire whilst in movement, let alone effectively protect himself by the ground. To-day bullet-proof armour, rendered portable through petrol power, enables him to concentrate all his energy on hitting his adversary in place of dividing it between hitting and securing himself against being hit.

7. *The Present Tank Tactical Theory.*

Up to the present, the theory of the tactical employment of the tank has been based on trying to harmonise its powers with existing methods of fighting, that is, infantry and horsed artillery tactics. In fact, the tank idea, which carries with it a revolution in the methods of waging war, has been grafted on to a system, a system it is destined to destroy, in place of being given free scope to develop on its own lines. That this should have happened in the practical use of the tank on the battlefield has been unavoidable on account of the novelty of the idea, the uncertainty of the machine, and ignorance in its use.

Knowledge can best be gained by practical experience, and generally this experience is impossible without first grafting the new idea for test to the existing system of war. Nevertheless, it behoves us not to forget that the tank (a weapon as different from those which preceded it as the armoured knight of the middle ages was from the unarmoured infantry which preceded him), will eventually, as perfection is attained and numbers are increased, demand a fundamental change in our entire tactical theory of battle.

The facts upon which our tactical theory has been based are now rapidly changing, and unless our present theory changes with them, we shall not be exploiting to the full the powers of this new machine, *i.e.,* the possibility of moving rapidly in all directions with comparative impunity to small-arm's fire.

From this characteristic we can deduce the all-important fact that infantry as at present equipped and known will become at first a subsidiary and later a useless arm on all ground over which tanks can operate. This fact alone revolutionises our present conception of war, and introduces a new era in tactics.

8. *The Strategical Objective.*

Irrespective of the arm employed, the principles of strategy remain immutable, changes in weapons only affecting their application. The first of all strategical principles is "The Principle of the

Object,"[1] the strategical object being "The destruction of the enemy's fighting strength."

This can be accomplished by various means, the present being the destruction of the enemy's field armies—that is, his fighting personnel. Now the potential fighting strength of any body of men rests on its organisation, and if we can destroy this organisation, we have destroyed its fighting strength and so accomplished our object.

There are two ways of destroying an organisation:

(i) By wearing it down (dissipating it).
(ii) By rendering it inoperative (unhinging it).

In war, the first comprises the killing, wounding, capturing and disarming of the enemy's soldiers (body warfare). The second, the rendering inoperative of his power of command (brain warfare). Taking a single man as an example, the first method might be compared to a succession of slight wounds which eventually cause him to bleed to death; the second—a shot through the head.

The brains of the army are its Staff—Army, Corps and Divisional Headquarters—could we suddenly remove these from an extensive sector of the enemy's front, the total collapse of the fighting personnel which they control would be but a matter of hours, even if only a slight opposition were put up against it. Even if we put up no opposition at all, but in addition to the shot through the brain, fire a second shot through the stomach, that is, dislocate the enemy's supply system behind his protective front, his men will starve to death.

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[1] The remaining Principles of War are:—The Principles of the Offensive, Security, Concentration, Economy of Force, Movement, Surprise and Co-operation.

(These are the eight principles of war adopted by me before the publication of my book *The Foundations of the Science of War*, in 1926.—J. F. C. F.).

Our present theory, based on our present weapons, weapons of limited range of action, has been one of attaining to our strategical object by brute force, that is, the wearing away of the enemy's flesh, muscles and blood. To accomplish this rapidly by means of tanks, it has been worked out that many thousands of these machines will be required. As there is little likelihood of obtaining the requisite number rapidly, I suggest that we search for some other means, always remembering that, probably, at no time in the history of the war, has a difficulty arisen the solution to which has not, *at the time in question,* existed in some man's head, frequently in those of several. The main difficulty has nearly always lain not in the solution itself, but in the acceptance of the solution by those who have vested interests in the existing methods.

As our present theory is to destroy " personnel," so should our new theory be to destroy " command," not after the enemy's personnel has been disorganised, *but before it has been attacked,* so that it may be found in a complete state of disorganisation when attacked. Here we have the highest application of the principle of Surprise, surprise by novelty of action, or the impossibility of counteraction, even when the unexpected has become the commonplace.

There are only a few commanders in the field as compared to fighters, therefore, the means required to destroy these commanders will be far less than those heretofore demanded.

It is no longer a question of—if Napoleon had possessed a company of machine-guns at Waterloo, would he not have won the battle, but one of—had he been able to kidnap or kill the Duke of Wellington and his Staff at 9 a.m. on the 18th June, 1815, would he not have done equally well without scarce firing a shot? Would not the sudden loss of command in the British Army have reduced it to such a state of disorganisation that when he did advance he would have walked through it?

It is not my intention here to deprecate brute-force, but to show that much brute-energy, and loss of brute-energy may be saved and prevented if we make use of the highest brain-power at our disposal in applying it.

9. *The Suggested Solution.*

To render inoperative the command of the enemy's forces on any given front, it is first necessary to consider the requirements. As an example, I will examine the anatomy of the German Army (May, 1918).

From the German front line the average distance of nine of their Army Headquarters is 18 miles; of three Army Group Headquarters, 45 miles; and the distance of their Western General Headquarters is 100 miles. For the purposes of illustration we need only consider the 18-mile belt, which contains all Army, Corps and Divisional Headquarters.

To reach these, elaborate systems of trenches and wire entanglements, protected by every known type of missile-throwing weapons, have to be crossed.

To penetrate, or avoid, this belt of resistance, which may be compared to a shield protecting the system of command, two types of weapons suggest themselves:

(i) The Aeroplane.
(ii) The Tank.

the first being able to surmount all obstacles, the second to traverse them.

The difficulties of the first are great, for even if landing ground can be found close up to the headquarters concerned, once the men carried in the aeroplanes are landed they are no better armed than the men they will meet, in fact, they may be compared to dismounted cavalry facing infantry.

The difficulties of the second are merely relative. We have not at present got a tank which would carry out the work satisfactorily, but there is no reason why we should not have one in a year's time if all energies are devoted to its design and production. The idea of such a tank exists, and it has been worked upon by a good many brains, I will call it the Battle-Cruiser Tank, and lay down for it the following specifications:

(i) To move at a maximum speed of 20 miles an hour.
(ii) To possess a radius of action of 200 to 300 miles.
(iii) To be able to cross a gap of 13 to 14 feet.
(iv) To be sufficiently light to cross ordinary road, river and canal bridges.

10. *The Tactics of the Battle-Cruiser Tank.*

The tactics of the Battle-Cruiser tank will be based mainly on the principles of movement and surprise: the whole object of its action being to accentuate surprise by movement, not only rapid, but unexpected. We must never do what the enemy expects us to do; instead, we must mislead him, that is, control his brain by our own. We must suggest to him the probability of certain actions, and when action is demanded, attain it by means diametrically opposed to those we have suggested to him by our previous preparations.

Thus, in the past, when we massed men and guns opposite a given sector, he did the same, and so frustrated our attack by making his defence so strong that we could not break through it and disorganise it. At the battle of Cambrai, when the method was reversed, the initial blow could not be taken advantage of, because, though we broke through the enemy's defences, the strength of the force broken through was not sufficient to cause more than a local disorganisation. The enemy's strength was not in the front line, but behind it; we could not in the circumstances disorganise his reserves. It is the reserves which always count—the human capital.

A study of Napoleon's tactics demonstrates the fact that the first step he took in a battle was not to break the enemy's front, and then, when his own men were disorganised, risk being hit by the enemy's reserves; but instead, to draw the enemy's reserves into the fire fight, and then, when once these were pinned down, to break through or envelop them. Once this was accomplished, there was no more opposition to be expected, consequently a pursuit could be carried out, a pursuit being more often than not initiated by troops disorganised by victory against troops disorganised by defeat.

Before the Third Battle of Ypres had commenced, we had drawn in large quantities of the enemy's reserves; this, judged by the Napoleonic standard, was correct; where we failed was that, once we had drawn in these reserves, we had no Old Guard disposable to smash them.

At the Battle of Cambrai we struck with our Old Guard (tanks) before the German reserves were on the battlefield. It was a blow in the air, and the result was that we crashed through the enemy's front, and then, when the enemy's organised reserves were brought up, having no Old Guard to meet them, the tactical advantage was theirs and not ours—we were repulsed.

Tactical success in war is generally gained by pitting an organised force against a disorganised one. This is the secret of Napoleon's success. At Ypres we had not the means to disorganise the enemy, at Cambrai the enemy did not offer us the opportunity to disorganise him, both battles being conceived on fundamentally unsound tactical premises. What we want to aim at now is a combination of the above two ideas—

(i) To force the enemy to mass his reserves in a given sector.
(ii) To disorganise these reserves before we break through them.

This done, pursuit, that is the tactical act of annihilation, becomes possible; pursuit produces the dividend of the battle.

The more reserves we can force the enemy to mass and we can disorganise the greater will be the tactical interest on our capital. With the Battle-Cruiser tank and the aeroplane there is no reason why we should not receive 100 per cent. interest on our investment. This represents the winning of a war in a single battle.

11. *The Battle-Cruiser Tank Battle.*

A battle based on the power of the Battle-Cruiser tank may briefly be pictured as follows:

A frontage of attack of some 100 miles is selected, and on this frontage, by the inducement of visible preparation, some four or five enemy armies are collected.

The area between enemy's Army Headquarters and his Divisional Headquarters will constitute the zone of the Primary Tactical Objective, and not as heretofore the zone of the enemy's guns; this latter zone will form the Secondary Tactical Objective.

Once the preparations are well in hand, without any preliminary tactical action, fleets of Battle-Cruiser tanks should proceed at top speed by day, or possibly by night, directly onto the various Headquarters allotted as their objectives. If by day, these objectives should be marked by aeroplanes dropping coloured smoke, if by night, by dropping coloured lights. As the farthest distance to be covered may be taken at 20 miles, the Battle-Cruiser tanks should reach the enemy's Army Headquarters in about 2 hours.

Meanwhile, every available bombing machine should concentrate on the various supply and road centres. The signal communications should not be destroyed, for it is important that the confusion resulting from the dual attack carried out by the Battle-Cruiser tanks and aeroplanes should be made known to all as soon as possible. Bad news confuses, confusion stimulates panic.

As soon as orders and counter-orders have been given a little time to become thoroughly epidemic, a carefully mounted tank, infantry and artillery attack should be launched, the objective of which is the zone of the enemy's guns, that is, a zone some 10,000 yards deep.

Directly the penetration has been effected, the pursuit should begin, the pursuing force consisting of all fast tanks available and lorry-carried infantry. To render this force doubly effective it should be preceded by squadrons of Battle-Cruiser tanks which will secure all centres of communication, break up hostile Army Group Headquarters, and disperse all formed bodies of troops met with. The enemy's General Headquarters might be dealt with by dropping several hundred tons of explosive upon it—this, at least, would neutralise clear thinking.

12. *The Effect of the Battle-Cruiser Tank on Tactics Generally.*

The improvement in any one arm, especially an improvement in mobility, will affect the utility and employment of all the remaining arms in a degree proportionate to the improvement. Taking now the other arms—infantry, cavalry, artillery, Royal Air Force, Royal Engineers and Royal Army Service Corps, in turn, the following are the influences deducted:

(i) *Infantry.*—Except for the gaining of the secondary zone, infantry on their feet will be next to useless. They will have to be carried forward if they are ever to keep up with the pursuit of the Battle-Cruiser tanks which will advance to a minimum depth of 20 miles a day.

The employment of infantry will probably be on the following line:

(*a*) To assist in the primary penetration.
(*b*) To operate in areas unsuited to tanks.
(*c*) To act as garrison to localities reduced by the Battle-Cruiser and other tanks.
(*d*) To protect the rear services.

After the first blow, the likelihood of infantry having to attack will be considerably reduced, their chief duty being to form a mobile protective line behind the Battle-Cruiser tanks in order to secure the administrative and engineering services. If this is correct, their tactics will be defensive, and their chief weapon should, consequently, be the machine-gun.

(ii) As regards cavalry, if cavalry are turned into mounted machine-gunners, and have sufficient endurance to keep up a pursuit of at least 20 miles a day for a period of 5 to 7 days, their tactical value as battle police will be considerable, for they will be able to form mobile mounted skirmishing lines between the groups of Battle-Cruiser tanks, and it may be assumed that, even if the entire cavalry force becomes dismounted by the end of the seventh day, the enemy, after a pursuit of 150 miles, will be reduced to a non-fighting condition.

(iii) *Artillery.*—The heavy artillery will disappear as a mobile arm after the first day's advance, and will be relegated to its original position in the siege train, and the field artillery, if still horse drawn, will be unable to keep up with the fighting after the second or third day. Field artillery horses must, therefore, be replaced by tractors; this, even to-day, is becoming a necessity on account of the difficulty in keeping horses alive on, or behind, the battlefield.

(iv) *Royal Air Force.*—As the mobility of the tank increases, so will it have to rely on the aeroplane more and more for its self-preservation.

The duty of the Royal Air Force will be as follows:

(*a*) To act as an advanced guard to the tank operations.
(*b*) To assist tanks in disorganising the enemy's headquarters.
(*c*) To guide tanks onto their objectives.
(*d*) To supply special advanced squadrons of tanks with petrol, ammunition, etc.
(*e*) To protect tanks from hostile gunfire.
(*f*) To act as messengers between tanks and their base.
(*g*) To carry tank brigade commanders above their operation sectors during the battle, so that these officers may be able to see what their machines are doing, and handle their reserves accordingly.

Aeroplanes will bear to tanks in the future a similar relationship as cavalry did to infantry in the past.

(v) *Royal Engineers.*—The duties of the Royal Engineer and Pioneer units will be considerably enlarged. Their work will be chiefly confined to the improvement of communications, roads and rails, and the building of bridges; all defence work will be relegated to the infantry.

(vi) *Royal Army Service Corps.*—The mobility of the Royal Army Service Corps will be taxed to the utmost. Horses will disappear, and road lorries will have to be supplemented by field lorries if the troops are to be adequately supplied. All road lorries should be easily convertible into field lorries by some simple wheel attachment which will enable them to traverse grass and plough land.

The main fact to be deduced from the above is that the mobility of the Battle-Cruiser tank will increase the mobility of all the other arms, draught horses will disappear, and by degrees riding horses as well. Consequently, the more mobile arms will prove the most useful, the less mobile either disappearing from the battlefield, or being brought up to the requisite standard of mobility by mechanical means.

13. *The Effect of the Battle-Cruiser Tank on Grand Tactics.*

The effect of the mobility of the Battle-Cruiser tank on Grand Tactics (the penetration or envelopment of an enemy) is almost beyond appreciation. Penetration of existing defences becomes considerably easier than the old field attack over an untrenched ground; envelopment a mere matter of leisurely manœuvre.

Besides these advantages, frontages of attack can be extended out of all former proportion to the strength of the attacking forces, and surprise form the base of every action.

As long as the enemy is unable to meet the Battle-Cruiser tank by a similar or suitable weapon, all attacks based on its powers will become methodical, that is, they will be carried out according to a definite plan, and disorganisation of the rear services will cease through the initiative being always ours, the enemy being forced to act according to our will and not his own.

14. *The Effect of the Battle-Cruiser Tank on Strategy.*

Strategy, or the science of making the most of time for warlike ends, that is, of opportunity, will practically cease for that side which pits muscular endurance against mechanical energy.

The possibility of applying naval tactics to land warfare is an entirely new application of the strategical principles which endows the side which can so apply them with an incalculable power. Formerly, strategy depended on communications, now communications will become universal, and though roads and rails will not cease to exist, they will become but lines of least resistance to movement in the universal vehicle into which the earth's surface will be turned by all types of cross-country machines.

CHAPTER V.

THE INTRODUCTION OF MECHANICAL WARFARE ON LAND.(1)

The war at an end, all armies reverted to their pre-war footing. It was an extraordinary *volte face* seeing that the armies of 1914 did not win the war, but that so far as the war was won tactically, gas, aircraft and tanks played the leading parts. In October 1918 the offensive power of infantry was negligible, unless supported by masses of guns or large numbers of tanks. Six months later infantry were reinstated as the queen of the battlefield, and all other arms—cavalry, artillery, aircraft, tanks, etc., were officially declared to be ancillary to infantry, further, that without the rifle and the bayonet, battles could not be won. This was an extraordinary situation, for during the war infantry as attackers had played a decreasingly important part. In 1917 and 1918 they stood in the wings of the battle stage, and, only after gun or tank had played its part, did they walk on to the stage and bow to the audience. What, however, was more disastrous was the official lethargy which enwrapped the new arms. This was more detrimental than the open opposition accorded to every novelty as explained in this chapter.

1. *Opposition to the Coach.*

In 1565 it is recorded that the first coach constructed in England was built for the Earl of Rutland, but on account of the execrable condition of the roads of this period, and the dangers of the highways, it was not until 1669 that systematic journeys were attempted in England, and then only between Oxford and London.

Coaching was a novelty, and like every rational and profitable novelty, before or since, its progress met with strong opposition. Early in the seventeenth century a Bill was brought before Parliament in order "to prevent the effeminacy of men riding in coaches"; and in 1671, Sir Henry Herbert, M.P., stated that "if a man were to propose to convey us regularly to Edinburgh in coaches in seven days, and bring us back in seven more, should we not vote him to Bedlam." Nevertheless the coach for its period had come to stay, and on October 13, 1712, a weekly service was instituted between London and Edinburgh. The journey was made in thirteen days, and the fare was £4. 10. 0.

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(1) *The Royal Engineers Journal,* January, 1921.

2. *Opposition to the Locomotive.*

In 1641, that is, twenty-eight years before the first coaching service was instituted in England, the Marquis of Worcester, famous as the inventor of an early steam engine, went to see Solomon de Caus in the Bicêtre at Paris. Marion de Lorne, who was with him when he visited this madhouse, wrote as follows:

"We were crossing the court, and I, more dead than alive with fright kept close to my companion's side, when a frightful face appeared behind some immense bars, and a hoarse voice exclaimed: 'I am not mad! I am not mad! I have made a discovery that would enrich the country that adopted it.' 'What has he discovered?' asked our guide. 'Oh!' answered the keeper, shrugging his shoulders, 'something trifling enough; you would never guess it; it is the use of the steam of boiling water.'" Why was Solomon de Caus there? To keep his brain from mischief; he had actually suggested that carriages and ships could be propelled by steam!

In 1769, James Watt invented the first practical steam engine. He also was considered mad, but fortunately for prosterity he was not locked up. In 1804 a locomotive guided by rails attained the speed of five miles an hour at Merthyr Tydvil, and ten years later, George Stephenson, financed by Lord Ravensworth, to whom was applied the adage: "A fool and his money are soon parted," began work on the Killingworth Railway. He met with immediate obstruction, Lord Eldon saying: "I am sorry to find the intelligent people of the North country gone mad on the subject of railways."

Stephenson was undaunted, and, in 1821, before the Stockton and Darlington line was completed, he said to his pupils: "Now lads, I venture to tell you that I think you will live to see the day when railways will supersede almost all other methods of conveyance in this country—when mail-coaches will go by railway, and railroads will become great highways for the King and all his subjects. The time is coming when it will be cheaper for a working man to travel on a railroad than to walk on foot."

To this the *Quarterly Review* incredulously exclaimed: "What can be more palpably absurd and ridiculous than the prospect held out of locomotives travelling TWICE AS FAST as stage coaches! We should as soon expect the people of Woolwich to suffer themselves to be fired off upon one of Congreve's ricochet rockets, as trust themselves to the mercy of such a machine going at such a rate. We will back old Father Thames against the Woolwich Railway for any sum. We trust that Parliament will, in all railways it may sanction, limit the speed to EIGHT OR NINE MILES AN HOUR, which we entirely agree with Mr. Sylvester is as great as can be ventured on with safety."

Once the locomotive began to crawl, the sluice gates of abuse were opened, and its inventor met with obstruction at every turn. A meeting of Manchester ministers denounced the railway as being " contrary " to the law of God. Lord Derby drove the railway surveyors off his land, and Stephenson had to hire a prize-fighter to carry his theodolite in order to prevent it being smashed to pieces. Pamphlets were written and newspapers hired to revile his work. It was declared that the railway would prevent cows grazing, hens laying, and " would cause ladies to give premature birth to children at the sight of these things going forward at the rate of four and a half miles an hour."

Parliament supported the reactionaries; birds would be killed by the smoke, foxes would become extinct, horses would be useless, and oats and hay unsaleable; country inns would be ruined, boilers would burst and blow passengers sky high, and finally, the weight of the locomotive would prevent it moving.

Nevertheless Stephenson persisted, and was besought by William Brougham not to talk too much about speed before the Parliamentary Committee which was to enquire into the question, or else he would "inevitably damn the whole thing and be himself regarded as a maniac fit for Bedlam."

The Committee of the House of Commons assembled on March 21, 1825, and the opposing counsel addressed these words to the great inventor:

"Suppose, now, one of these engines to be going along a railroad at the rate of nine or even ten miles an hour, and that a cow was to stray upon the line and get in the way of the engine; would not that, think you," asked the barrister, "be a very awkward circumstance?"

"Yes," replied George Stephenson, with his face in a humorous pucker, "very awkward indeed —*for the coo!*"

3. *Opposition to the Tank.*

Why have I told you all this? In order to avoid relating to you the studied opposition which was meted out to the tank. It is right and necessary that you should realise this, for on your support, in future years, will depend the progress of mechanical warfare, which is the subject of this lecture.

In 1914 was the tank conceived; in 1915 was it built; in 1916 was it first made use of; in 1917 did it fight for its existence, and in 1918, I go so far as to say, that without its assistance we should not that year have won the war. In 1919, an experimental machine attained a speed of 20 miles an hour; and now in 1920, is it still struggling against difficulties, for prejudice to things new dies hard, and vested interest is a powerful adversary.

Whatever the tank has accomplished, it is still far from perfect, it is still in the Puffing Billy stage of 1822; Puffing Billy which George Stephenson was wont to drive close by his brother's house, and when it stuck fast at a curve, he would shout out to his wife: "Hey! Jean, come oot, and gie us a shove roond the turn!" Twenty years later we read: "A few years since ninety-four coaches used to pass through St. Albans daily. On Saturday last the Leeds Express, formerly called the 'Sleepy Leeds,' which has been on the road upwards of a hundred years, ceased running, it being no longer a profitable speculation."

The coach was dead, the railway had come into its own, a new and stupendous world was born, and through mechanising civil movement, by replacing the horse by the steam engine, civilisation has advanced more rapidly during the last eighty years than she had advanced during the preceding eight thousand.

Here then is the gist of my lecture. What the locomotive has done for civilisation, will the internal combustion engine do for war. It opens up before us a new world of warfare, stupendous in its possibilities. Let us enquire into it, and do not let us fall into a frenzy because possibly rifles and swords, bayonets and lances, horses and limbers may disappear, for even if they do, we may be perfectly sure that things more efficient will replace them.

4. *Opposition to the Rifle.*

I will now turn for a few minutes to what I will call the coaching period in the history of the war, chiefly in order to obtain a background whereon to throw into relief the future tendencies of mechanical warfare.

In the fifteenth century, gunpowder was considered useful for frightening horses: a century long argument then followed, concerning the bow and the musket, and as many arguments were launched for the retention of the bow as to-day are quoted for the retention of the lance. The bow has, however, vanished, but not without a struggle, for as late as 1797 a certain Mr. Mason once again proposed to equip British infantry with it.

In 1742, Benjamin Robins, in his "New Principles of Gunnery," made a remarkable prophecy as to the eventual adoption of the rifle, which, however, did not take place until a hundred years after his day; he says:

> ". . . . whatever State shall thoroughly comprehend the nature and advantage of rifled barrel pieces, and having facilitated and completed their construction, shall introduce into their armies their general use, with

> a dexterity in the management of them, will by this means acquire a superiority which will almost equal anything that has been done at any time by the particular excellence of any one kind of arms, and will, perhaps, fall but little short of the wonderful effect which historians relate to have been formerly produced by the first invention of firearms."

In 1780, Major Patrick Ferguson invented a breech loading rifle. He paid for its manufacture out of his own pocket, and equipped his men with it so that they might meet, on equal terms, the American backwoodsmen. He then, unfortunately, went sick, and Lord Cornwallis, the Commander-in-Chief, had the rifles withdrawn and destroyed.

In 1824, the British Government refused to accept Captain Norton's cylindro-conoidal bullet. It was reproduced by Captain Minié of the French Army in 1849. The Minié rifle became the weapon of the day, nevertheless, Sir William Napier strenuously opposed it, as in his opinion, it would destroy the infantry spirit by turning infantry into what he called " long range assassins."

In 1858, Greener declared the " time and ingenuity spent in planning and constructing breech-loading cannon will always end in disappointment and failure," and again, that "striving to produce perfect breech-loading cannon is like striving to square the circle." Consequently the British Army did not receive such a weapon until 1886. Even as late as 1895, when the *Victoria* went down with Admiral Tryon, some of her guns were still muzzle-loaders.

In spite of opposition, the breech-loading rifle and field gun—which I will call the "military coach," for both depended on muscular movement—came into their own.

5. *Phantom Wars.*

In August, 1914, the finest muscularly organised body of troops ever raised by Great Britain left her shores. I was fortunate enough to see them, and I can frankly say that in all my life I have never, before or since, seen such a perfect force of men and horses as those of the 7th Division and the 1st Cavalry Division which sailed for Zeebrugge and Ostend. A fortnight later the 7th Division had almost ceased to exist. What had happened?

Many things, amongst them one, to my mind the most important, which for long remained obscure. The war we had prepared for was a phantom, a will o' the wisp, which literally led us off the highway of progress into a "slough of despond."

What had we failed to realize? We had not realized this—that an Army to prosper must be based on the civil sciences, that an Army must keep pace with the progress of industry, and that an Army which does not do so is but a phantom force for war.

6. *Irresistible Science.*

Since 1842, when the "Sleepy Leeds" had run her last journey on the Great North Road, what had been happening in civil life? a mechanical evolution, so rapid that no revolution in the whole world's history can compare to it. Every day brought to birth some new invention, every hour civilisation gathered greater speed; epochs crumbled away, epochs sprang up in the night, science was sweeping brute force off the face of the earth, and was replacing muscle by mechanical energy.

In 1885, Gottlieb-Daimler designed the first practical internal combustion motor. In 1896 the first motor car in England ran from London to Cambridge, preceded by a man carrying a red flag. Parliamentary opposition was revived, humanity could not live with the road car, the roads would become unsafe, children would be run over, dogs and fowls exterminated, and carts overturned. The country gentleman got his back up, but the Rolls-Royce soon got it down.

In 1770, the first patent for a footed wheel was registered; in 1888, an agricultural tractor, almost identical to the future tank, was designed; in 1907, a motor car on tracks attained the speed of 20 miles the hour on firm sand. In 1909, at the first flying meeting held at Reims, General Grierson, an able soldier, watching an aeroplane, turned to General Stone, and said: "I say, Stone, do you really think there is anything in it?" and General Stone's comment on this remark is worth recording: "That is only ten years ago, and it is a very striking fact that such a very short time ago as that some of the best brains in the Army (because I could mention other names, but I do not think it would be wise to do so) thought that anybody who took up flying seriously was a little 'gone in the head.' I speak of what I know."

It is indeed easy to be wise after an event, but surely it is better to be thus wise than never to be wise at all. In 1914, the armies of Europe marched forth to fight Worth, Gravelotte and Sedan over again, forty-four years of scientific progress had been neglected, and the bill—10,000,000 men killed and over £60,000,000,000 expended. In 1918, the war was costing Great Britain £300,000 an hour, or the present price of the yearly upkeep of two infantry battalions. Gentlemen, science is worth studying.

7. *The Nature of the Great War.*

Let us turn for a few minutes to the nature of the Great War. One of its most remarkable features was that it resembled the battle of Marathon (B.C. 490), for the greater portion of its duration the war had no flanks. Why? Because the enormous size of armies enabled battle fronts of upwards of 500 miles to be held in strength, entrenched and wired. What had rendered this possible? The locomotive, the railway, and the steamship, the great mechanical movers of civil life. Soldiers had not considered them very deeply; then, when war was declared, they, like great funnels, poured forth men in cataracts. Immense tracts of country were inundated, and for over three years, on the Western Front, armies lay opposite each other in stagnating puddles, and slowly evaporated away.

We see a strange sight: millions of men facing each other, millions of men, the subsistence of which, prior to battle, depended on every yard of rail and road behind them being utilised to the full. Lorries and locomotives worked day and night to supply this enormous muscular mass, to pile up the military coaches which, from time to time, were launched from their mechanical base into battle areas devoid of railways and all but devoid of roads. What do we then see? We see strings of pack mules and thousands of human carriers wallowing through the mud; in a single day the administrative needs of the Army have increased tenfold, and the means of supplying these needs have retrogressed by several thousand years. This brings me to our first main problem in mechanical warfare, the problem of road capacity.

8. *Road Capacity.*

In August, 1915, a metre gauge railway ran from Gezaincourt to Albert, and I suggested to an officer, quite an able man, that if a certain British Corps made use of it, considerable economies could be effected. His answer was: "It can't be done, for if we use this railway we shall disorganise the whole of our lorry service!."

In the eighteenth century, the Squire who brought his wife to London sitting behind him on his cob, objected to the stage coach. In the nineteenth century he had accepted the stage coach but objected to the locomotive. In the twentieth, he accepted the locomotive and fell foul of the motor car. And so in 1915, we find an able officer objecting to the light railway. Why? Because of what I will call congenital prejudice, which can only see the means and not the end, and which, having made a hobby of the means, refuses to see the end. I will give you a typical example of this.

In the first decade of this century, a meeting of the Directors of the London General Omnibus Company was held. A young engineer got up and suggested the replacement of horses by petrol engines; he pointed out that the shares of the Company stood at a low figure, and that he could raise them several hundred per cent. This so enraged one of the elderly Directors, who could only see the existing means—the horse—and not the end, a high dividend, that, trembling with rage, he exclaimed: "You may take it from me, Sir, that the horse will remain the backbone of this Company for many, many years to come." Within a few years of this prophetic outburst the horse in the L.G.O. had disappeared, and the Company's shares stood at a price far higher than the young engineer had ever dreamt of.

In 1914, a few score of lorries formed the mechanical equipment of the British Army. In 1917, they had grown in number to about fifty thousand, hundreds of miles of new railways and thousands of miles of tramways covered the

British fronts. For three years we had been fighting for road capacity, and behind our front line we had attained it, but in advance of it, it ceased to exist. Armies became like caged animals, they could move about in their own prisons at will and in perfect safety, but to escape from them was next to impossible.

I will take a few examples to illustrate this, and will select them out of the events of the last year of the war, during which the bars of the cages had become somewhat more elastic:

(i) In March, 1918, the Germans gained against us an overwhelming success; they advanced some 40 miles in 14 days and were then forced to halt. To many who took part in this operation, it was apparent that it was not the British Army which caused this halt, but the weakness of the German Army due to the "petering out" of its supply system. Road capacity in the Somme area was limited; want of road capacity, which might well have been foreseen, completely wrecked the last chance the Germans had of winning the war.

(ii) In May, 1918, the Germans gained another overwhelming victory, this time over the French, the result of which was an advance of 30 miles in 4 days, and the formation of the Château Thierry salient. As long as Soissons remained under gun fire and Reims held out, road capacity, from the railway point of view, was to all intents and purposes non-existent. To remain in this salient without road capacity was to commit suicide. This is exactly what the Germans did.

(iii) In August, 1918, we attacked eastwards of Amiens; behind us was an efficient railway system, in front of us good roads, which, during the battle, were never much damaged; nevertheless, our initial success, which was stupendous, rapidly "petered out" after the first day's fighting. This was due to several reasons, one being the difficulty of maintaining the energy of the battle by supply, in other words, road capacity was insufficient to enable us to continue the advance, which would have been more difficult still had we attempted to force our way across the old Somme battlefield.

The lesson to be learnt from all this fighting, and probably the most important lesson to be learnt from the whole war is that the chances of victory or defeat are multiplied directly by any increase or decrease of road capacity in an area of operations, and that unless road capacity be equal to the supply requirements of the attack, either the attackers must eventually die of starvation or the attack must be abandoned.

This problem may be viewed under two main headings:

(i) Means of cutting down the necessity of supply.

(ii) Means of increasing the transportation of supply.

I do not intend to discuss the first beyond saying that the quicker an army can move, the less supplies in the long run will it require. As regards the second, it may be viewed under four subsidiary headings:

(*a*) Concentration of traffic.
(*b*) Additional road space.
(*c*) Additional roads.
(*d*) Dispensing with roads.

The first is gained by increasing the tonnage per road mile. The second by constructing vehicles which will move alongside a road over plough and glass land. The third by making use of badly metalled roads, or by building new ones. The fourth by cross-country traction which will enable all normal country, plough and grass land, desert and scrub, to be crossed as easily as a lorry to-day will move along an average road.

Can such a machine be obtained? It can!

9. *The Administrative Link.*

What will the cross-country lorry accomplish? It will mechanically link up the strategical base of operation, which consists of a network of railways, with the battlefield itself. No longer will there occur that terrible hiatus between railheads and battle dumps. You won't dump, but you will move. As the battle starts so will it be continued, there will no longer be an exchange of supply horses in mid-stream. Right through the Great War this problem remained all but unrealized, and only towards the end was any notice taken of it, and yet on its solution depended the dividend of every attack.

Often was the question asked: What happens when a penetration has been effected? The answer is: Push up supplies, supplies of men, weapons, munitions, and food; the side which can do this the more quickly is the side which is more likely to win. The problem is, consequently, not so much a tactical as an administrative one, and, looking back, it can now be seen that the General Staffs of all armies never fully realized this.

10. *The Tactical Link.*

Given a mechanical strategical base and a mechanical supply system, logically, the next link to forge is a mechanical tactical striking force. In other words, to cease hauling up to the front innumerable military coaches by means of mechanical power, as the old four-decker sailing ships were towed into position opposite Sebastopol and towed away again after an engagement, but instead to replace the coach by a military motor car, and so render the whole army from start to finish a mechanical one.

The necessity for this was realized early in the war by a few far-seeing men, and the result was the tank—a cross-country battery, which, protected by armour, was able to make use of protected mobility for offensive ends.

The idea of protected mobility gave birth to much mirth; one noted officer requested Colonel Swinton to abandon his "flights of imagination and come down to solid facts"; another, when he was informed that his troops were to be led by tanks through the Cambrai wire, exclaimed: "Fantastic! fantastic!" The press corespondents filled the newspapers with "slimy monsters and Gargantuan toads," but what was worse, a passive and effective barrier of obstructions was raised against all efforts of the Tanks Corps to expand.

A bad second to the obstructor was the amateur enthusiast, who, knowing nothing about tanks, expected them to perform miracles.

In 1829, George Stephenson was faced with the problem of running a railway over Chat Moss. Mr. Alderson obstructed, and made a speech opposing it which lasted two days in the Commons. Mr. Cropper, a Quaker, urged Stephenson on. "Consider, Sir," said Stephenson, "the heavy character of the works, and how much we have been delayed by want of money, not to speak of the wet weather. It is impossible."

"Impossible," retorted Cropper, "I wish I could get Napoleon to thee—he would tell the there is no such word as 'impossible' in the vocabulary."

"Tush!" said George Stephenson contemptuously; "don't talk to me about Napoleon! Give me men, money and materials and I will do what he couldn't do—drive a railroad from Liverpool to Manchester over Chat Moss!"

To-day we are faced with our Aldersons and our Croppers, but what we want is men, money, and materials and we will then do what neither Napoleon nor Stephenson could do; move men across country faster than the Rocket ran along her rails.

CHAPTER VI.

TANKS IN FUTURE WARFARE.(1)

The lethargy and opposition described in the last chapter were hotly attacked by a small band of tank enthusiasts who saw quite clearly that, as the present age was a mechanical one, it followed of necessity that the army would have to be mechanised. There was no question that this end was assured; in place the whole problem was to speed its advent, so that money might be saved, and what was more important still—casualties reduced during wartime. The difficulties which faced this small band of believers in mechanised warfare were great. First, they were confronted by a solid phalanx of hostile military tradition, and secondly, public opinion did not interest itself in the tank. To accomplish anything, public opinion had to be created, and it was considered that it could only be created by press propaganda. To attract the attention of editors, a spectacular machine had to be produced, and the result was that tank engineers set out to quadruple the speed of the old war tanks. This was the wisest step taken, for once a tank was built which moved at 20 miles the hour, its performances were mentioned in Parliament, and the Press became interested. Further still, it was essential to show that even the old war tanks did effect enormous economies as described in this chapter.

IF we examine with some introspection the consequences directly due to the war, we shall find that they may be divided into two categories—the positive and the negative. The first include financial liabilities, commercial instability, and territorial aggrandisement with their numerous concomitants—variable rates of exchange, increased taxation, inflation of prices, unemployment, and demands for military protection in order to reinstate social stability, particularly in our newly acquired possessions. The second category is less concrete in nature and, consequently, more difficult to grasp. We know that the world of to-day is not the world of 1913, we know that there has been a change, a change so rapid that we have not been able to fathom it, and not being able to do so, we find difficulty in diagnosing its present direction. But this direction must be discovered, for eventually the future will be based on the present; consequently what is required of us to-day is the materialisation of our visions, to convert them into concrete things which, though they may be still friable in nature, will not be mere phantoms of the imagination. To misquote Shakespeare, we must cease believing that:

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(1) *The Nineteenth Century and After,* July, 1921.

We are such stuff
As dreams are made on, and our little life
Is rounded by the Treasury;

for otherwise it certainly will be.

Bearing in mind the above, it is my intention in this article to examine only one factor from amongst this turmoil of factors, namely, the tank, and not from a purely military point of view, as appertaining to land operations only, but from one which will embrace the Royal Navy and the Royal Air Force as well, and so weld together the three great Defence Forces of the Empire into one elastic organisation. Before I do so, I intend, however, to examine the military characteristics which have differentiated the Great War of 1914-1918 from all previous wars. I do this for two reasons.

First, if the Great War can be proved

radically different from all preceding wars, we shall have a potent weapon at our disposal wherewith to club the reactionaries.

Secondly, in the radical changes themselves—that is, in the differences between the recent war and all previous wars—we may possibly discover a harmony which will lead to a closer co-operation between land, sea and air than has hitherto been possible.

Looking back over the four and a half years of the war, one thing is certain; neither the Army, Navy, nor the Air Force of 1918 resembles very closely the Army, Navy and Air Force of 1914, and accepting inference as a guide, we may postulate that, were it possible for another war on the scale of the last one to be declared to-morrow, and to last for four and a half years, there would be at least as great a difference between the Army, Navy and Air Force of 1925 when compared with those of 1921, as there was between those of 1918 when compared with those of 1914, and in all probability a greater one.

In peace time we cannot expect the rapidity of evolution attainable in war, but we must expect some evolution, for stagnation spells death, and retrogression—decay. Yet before we can expect this evolution, however slow, we must, as I have already pointed out, discover the differences between 1914 and 1918, and not discover only these differences, which is an easy task, but discover their influences, not only on pre-war organisation and equipment, but on pre-war ideas. Concerning this Admiral Mahan has very pertinently remarked:

> "The student will observe that changes of tactics have not only taken place *after* changes in weapons, which necessarily is the case, but that the interval between such changes has been unduly long. This doubtless arises from the fact that an improvement of weapons is due to the energy of one or two men, while changes in tactics have to overcome the inertia of a conservative class; but it is a great evil. It can be remedied only by a candid recognition of each change."

Now, though it is easy enough to discover that the main factors which gave to the Great War its differences when compared with previous wars, were, on land—the tank, at sea—the submarine, and in the air—the aeroplane, it is not so easy to arrive at the true influences of these weapons, or rather means of carrying weapons, neither do I intend to attempt such an analysis, except in the case of the first: nevertheless, it must not be forgotten that the oldest of these weapons, at least in its modern form, namely, the submarine, is scarcely twenty years old, and the youngest—the tank—not yet five; consequently, it would take a bold man to assert, and probably a very foolish one, that even the wildest statements at present made regarding these new means of movement are impossible. Nothing is impossible, not even a flying battleship which will walk over the Alps and dive to the bottom of the Atlantic. This is, however, no reason why we should abandon common sense and leap into a land of phantasmagoria; but at any rate let us continue in thought to crawl, we dare not stand still, for standing still is to kill all progress.

A record of what tanks accomplished in the Great War can scarcely be condensed into a few paragraphs, so in place of attempting so unprofitable a task, it is my intention to place before the reader certain statistics which, if they do not convince him that the tank is *the* weapon of the future, may at least raise doubts in his mind as to the present values of the other arms. I will deal with these statistics under the following five headings: (i) Fighting man-power; (ii) manufacturing man-power; (iii) expenditure of money; (iv) economy of transportation; and (v) economy of time; all of which constituted problems of the greatest importance during the recent war.

(i) *Fighting Man-Power.*—It must generally be agreed that the main use of the soldier in war is that of a weapon-mounting, since in modern warfare the soldier no longer fights with his fists, teeth and feet, consequently, one of the big problems in military organisation is to economise man-power without detriment to weapon-power. I will compare, in terms of weapon-power, a tank crew with the man-power required by certain of the other arms. A field gun requires 14 men, a machine-gun 6, a trench mortar 5, an aeroplane 2, and a tank machine-gun 1.3.

It may, however, be asserted that this is not a fair comparison, and that units in place of crews and teams should be considered. Let us then do so, and we shall find that an Artillery Brigade requires 32.6 men per gun; a Machine-Gun Battalion 14.5 men per machine-gun; a Trench Mortar Battery 6.2 men per trench mortar; a R.A.F. Wing of four fighting squadrons 5.9 men per machine-gun; and a Tank Battalion 3.07 men per machine-gun, or six-pounder.

Casualties are the main reducers of fighting man-power; let us then compare the casualties suffered in battles without tanks with those with them. On the first day of the battle of the Somme, July 1, 1916, when no tanks were used, the casualties were approximately 40,000. On the first day of the battle of Amiens, August 8, 1918, when 415 tanks were used, the casualties were slightly under 1,000. Between July and November, 1916, the first battle of the Somme, our casualties per square mile of battlefield gained were 5,300; during the same months in 1917, at the third battle of Ypres, they were 8,200; and during the same period in 1918 they were 83. In the third period alone were tanks used in numbers and efficiently.

It has often been stated that tanks were absolute death traps; this assertion is not founded on facts; of all arms the Tank Corps had the lowest percentage of men killed and died to total casualties; here then, are the figures: other arms (R.A.S.C., etc.), 27.39; cavalry, 23.33; artillery, 20.37; engineers, 20.35; infantry, 19.96; Machine-Gun Corps, 17.27; and Tank Corps, 12.58. This low figure in killed was not due to the men in the Tank Corps taking part in fewer actions than the other arms; in 1918 few infantrymen led the assault of a pitched battle more than four times, many tank soldiers did so as many as fifteen times. The answer is a simple one—12 mm. of steel plate is a better protection than human skin.

(ii) *Manufacturing Man-Power.*—As regards the tank as a saver of manufacturing man-power, many examples could be quoted. I will, however, examine only two: the man-power required to manufacture and handle the shells expended during the preliminary bombardments of the third battle of Ypres, and the man-power required to manufacture the tanks and shells used on the first day of the battle of Cambrai.

At Ypres, in the preliminary bombardments before the opening of the battle, 4,283,550 shells costing £22,000,000 were fired; this cost represents 176,000,000 man-hours at 2/6 an hour. If these man-hours be now divided by 300 days at 10 hours a day, a very liberal estimate, the number of men required to turn out these shells will be found to be 55,000.

At Cambrai, on the first day of the battle, 378 fighting tanks were used and 293,149 shells were fired; the tanks cost approximately £5,000 apiece, and the shells £5. Though only 48 tanks were hit on this day I will suppose that all were lost, then the total cost in tanks and shells was £3,350,000 and not £22,000,000, the saving was, therefore, £18,650,000, or 149,200,000 man-hours, which represents 49,400 men working for 300 days at 10 hours a day at 2/6 an hour. It might be noted here that 49,400 men represents the personnel of 67 tank battalions; at the battle of Cambrai 9 were used!

(iii) *Expenditure of Money.*—Economy in man-power, both fighting and manufacturing, is in itself an enormous economy in money; nevertheless, I will now take a more concrete case. During the war on an average a shell cost £5 and a tank £5,000; consequently, the cost of one tank was equivalent to the cost of 1,000 shells. A shell once fired is totally expended; a tank, accepting a very conservative reckoning, fights four engagements before being wrecked; therefore, the cost of one tank is approximately equivalent to that of 250 shells; consequently, had the cost of the 4,283,550 shells, fired in the preliminary bombardments of the third battle of Ypres, been spent on tanks, 17,134 machines could have been produced. At the battle of Amiens, August 8, 1918, which Ludendorff christened "The black day of the German Army," only 415 of these machines were used, and with decisive results.

Whether tanks won the war or not is outside the present question, but that they were economical as a means of assisting in winning the war can scarcely be doubted if the items in the expenditure of the Ministry of Munitions for 1917-1918 be examined. The total figure given is £672,164,933 divided into twelve categories; by far the smallest item quoted is for tanks, the cost of which is

£9,587,960; transport vehicles alone cost four times this sum.

(iv) *Economy in Transport.*—As an economy in means of transport I will take as an example the shells expended at the third battle of Ypres during the preliminary bombardments, and those fired on the first day of the battle of Cambrai.

At Ypres, the 107,000 tons of shells expended represent: 27 four-thousand ton ship-loads; 540 four-hundred ton train-loads (in England and France), and 35,666 three-ton lorry-loads.

The saving in tonnage for shells at Cambrai, when compared with Ypres, is 401,269 tons, and if 100,000 tons be deducted for the 378 tanks used on November 20, 1917, a very liberal allowance, a net saving of 300,000 tons is the result.

During the war it was frequently stated that tanks were so extravagant in petrol that shipping could not be found to supply a large force of these machines. What do statistics show? They show that the largest item shipped to France was not shells and ammunition, which totalled 5,500,000 tons, but hay and oats, which totalled 6,000,000, and which exceeded the petrol burnt by all motor vehicles, tanks and aircraft in France by well over 5,000,000 tons. If to these 6,000,000 tons of forage we add the shipping required for forage in other theatres of war, and to transport the 1,500,000 horses overseas which were transported, the total tonnage required by horses cannot have fallen short of the total tonnage of British shipping sunk by the German submarines during the war.

(v) *Economy in Time.*—Time is always a vital factor in war, and, from the military point of view, one hour is not 60 minutes, but what is accomplished in 60 minutes, and if, when compared with another, one man can accomplish twice as much in an hour, then he will have 30 minutes start over the other when the second hour's work commences.

Did the tank from the military point of view enable time to be economised? To show that it did I will compare the operations of the summer and autumn of 1917 with those of 1918. At the third battle of Ypres, between July 31 and November 14, 1917, an advance of about 12,000 yards was made; the average daily penetration was, therefore, 110 yards. Between August 8 and November 11, 1918, an advance of over 60 miles was effected, consequently, the average daily penetration was 1,100 yards. During the first of these periods the use of tanks was limited, during the second they were used in the van of nearly every attack, and the result was that the military hour was reduced to six minutes; in other words, ten times more work was done in the hour when tanks were used than when they were not.

Whether these statistics be considered exaggerated or not, the critic must remember that they have been culled from the history of a machine which of its type can at best be compared to the *Merrimac* and *Monitor* of the American Civil War, and that, as these ancient ironclads have to-day evolved into super-Dreadnoughts, there is no reason why, long before the next sixty years have elapsed, the present-day tank, with its low horse-power and its speed of from five to eight miles an hour, should not evolve into a super-landship. Be this as it may, one thing seems certain, namely, that infantry as foot soldiers, and cavalry as horse soldiers, and horse-drawn artillery, are not likely to increase their efficiency at the same rate as a machine which can add horse-power to horse-power.

To be in a position to appreciate the progress which is likely to be made in future tank design, it may be of interest if some of the limitations of the British Mark V tank are here mentioned, as from them will be realized the immense future possibilities which to-day face the tank-designer. The following were the main limitations of this machine which so materially assisted the British Army in 1918:

(i) That it was readily bogged on soft ground, the causes being—weight, high pressure per square inch, and unsprung tracks.

(ii) Its track grip was often found to be insufficient for climbing slippery slopes without the addition of special spuds.

(iii) It was defeated by water obstacles in the absence of bridges capable of taking its weight.

(iv) It possessed a very limited circuit of action, and consumed large quantities of petrol.

(v) Its over-all efficiency was largely bound up in excessive mud constriction in the track chambers, an enormous amount of power being absorbed in churning this mud.

(vi) Its speed was low, a Mark V tank having a maximum speed of five miles per hour.

(vii) Its means of providing vision for its crew were very defective. When topping a rise half the machine was visible to the enemy before anyone inside could see anything of the reverse slope.

(viii) It was defective in that much of the transmission had a very short life. The whole machine was very costly in spares.

(ix) Its control was defective in that it required great manual effort, thus exhausting the crew.

(x) Its ventilation was very defective, the main reason being that the fighting chamber and the engine room were in one. Fumes from the exhaust contributed to the difficulty.

(xi) Its protection against artillery fire was poor on account of lack of speed.

Taking into consideration what the tank accomplished during the recent war, and what improvements in design are likely to be effected in the near future, it logically follows that we are to-day confronted by a military problem of the first magnitude—namely, should we continue to adhere to an Army based on muscle, or should we not re-cast this Army and base it on machinery? We are, in fact, confronted by the same problem which confronted the Navy during the first sixty years of the last century, and, in my own opinion, there can be little doubt that, as eventually the Navy abandoned sails and took to steam, so will the Army abandon muscle as its motive force and take to petrol.

Before outlining the possibilities of so stupendous a military evolution, I will, for a moment, glance at our present Imperial situation and see if there are any factors which are likely to demand such a change.

We are to-day confronted by what I will call two key-problems: how commercially to recover from the ruinous cost of the war, and how, militarily, to secure our Empire against disorder, and guarantee a state of peacefulness now so necessary to our general recuperation.

The first problem is one of the creation of wealth, and the making good of five years' deficit. Every great advance in commerce has been initiated by a new or improved means of movement, such as the invention of the wheel, boat, sail and the steam engine. On land the wheel, moving either on road or rail, has made civilisation what it is to-day. It possesses, however, one serious limitation: it demands a road or railway for its free movement, and both are expensive items which our present impoverished condition does not permit us to entertain.

To-day we possess more undeveloped country than any nation has ever possessed before (except perhaps for Russia), and we cannot develop it until we can move over it. It would appear, therefore, that the only economical solution to this problem is to be sought for in a commercial cross-country tractor, which in such countries as East Africa, Canada, Mesopotamia and elsewhere, will enable large tracts of virgin country to be exploited which to-day are unremunerative because of their distance from the railways. If this solution be the correct one, civil cross-country traffic will give an enormous impetus to the mechanisation of the Army.

As regards the second problem, which is virtually one of securing our commerce in non-European and undeveloped countries, we possess an Army which is no larger than our Army of 1913, our military liabilities have increased, and the whole world is still in a turmoil. We cannot increase the number of our troops, for the cost of such an increase is prohibitive; but, if by mechanising our Army we double its speed of movement, we can indirectly halve the size of the territories it is called upon to safeguard. There is only one practical method of accomplishing this—the cross-country tractor which, moving at an average speed of eight or ten miles an hour, can cover in a day three to four times as much ground as an infantryman can on his feet.

We thus see that our present Imperial problem, the recreation of prosperity and its security, demands a radical change in both our civil and military means of movement.

To most of us any idea of change from methods we have become accustomed to is abhorrent. Gunpowder, stage coaches, steam power, steamships, locomotives, rifles, breechloading guns, motor cars, aeroplanes, tanks, etc., etc., have all in their day met with strong opposition, and the stronger it has been the more certain has been the change.

In fact, it seems almost to be a law of growth that all great revolutionary ideas or thoughts must pass through the fire of prejudice before they are refined into practical realities.

If the mechanisation of the Army be not voluntarily initiated by soldiers, it will be forced upon them by circumstances. Necessity will first of all compel us to mechanise the whole of our supply services and guns because horses of the right stamp are becoming unobtainable. As wheels will seldom carry lorries across country, tracks will be used. Necessity will then compel us to mechanise our machine-guns and infantry, and eventually out of great numbers of small mechanically propelled landcraft will emerge the battle fleets of future land wars, the component units of which will be as different from the tanks of to-day as the *Hood* and *Queen Elizabeth* are different from the *Merrimac* and the *Monitor.*

It is, however, not my intention in this present article to speculate regarding a distant future; in place I intend laying before the reader certain possibilities which may help us to solve our immediate problem, and those which are likely to confront us within the next few years.

Before the outbreak of the war our Defence Forces consisted of a Navy and an Army; the former was organised for war and its strength was based on the principle of two keels to one; the latter was organised for peace, and it was based on no military principle whatsoever. The Expeditionary Force consisted of 6 Divisions, not because the number six denoted any military value, but because the normal unemployment in the United Kingdom provided some 30,000 men annually, who, on a 7 years' enlistment, enabled 6 Divisions to be maintained.

Before 1914, between our war-organised Fleet and our peace-organised Army there was but little co-operation, and to-day this state continues; further, to-day, to the two pre-war Defence Forces we must add a third—the Royal Air Force, with which, from both a naval and a military point of view, there is at present but an attenuated co-operation.

Co-operation simply means working together, or combining each other's powers to work, so that the maximum result may be obtained from the minimum effort. There are two factors which must here be considered: first, the knowledge o each other's limitations, and secondly, the harmonisation of each other's differences. I will now consider these two factors from the point of view of movement, offensive power, and means of protection, the three material elements which build up the compound called tactics.

Military Limitations.—Strategically an army is based on the locomotive and steamship, tactically on human and animal muscle. The result of this is that though the former enables vast quantities of men to be concentrated in a theatre of operations, the latter restricts their movement in direct proportion to the size of the masses concentrated. Further, that as all movement of supplies is by road and rail, an army in the field virtually possesses but a one-dimensional power of movement, it can move up and down roads, but it can seldom move away from them.

As regards its offensive power this is limited to the carrying powers of man and horse, and as these cannot be increased, all radical changes in the power of weapons are strictly limited. The same difficulty applies to protection. The soldier can protect himself indirectly by his weapons, and directly by seeking cover by ground, but direct protection by armour he cannot carry, neither can infantry and artillery fire whilst in movement; in fact, muscular limitations are the keystone to nearly all our tactical difficulties which, in bulk, render an army a most complex organisation.

Naval Limitations.—Since the sails of warships were replaced by steam power, naval strategy and tactics have been based on a common motive force which has rendered the movement of fleets two-dimensional, that is to say, ships can move in any direction on a plane surface—the sea; further than this, certain vessels can submerge, and so possess a third-dimensional power of movement, which enables them to seek protection by water as the soldier on lands seeks protection by ground. Of all fighting vehicles, or weapon-mountings, ships can carry the most powerful weapons and the heaviest armour. The main limitation of the ship is that she cannot leave the water, and that as human beings do not live on water they (normally) must be defeated on land.

Air Force Limitations.—The aeroplane possesses a three-dimensional power of movement and enormous speed. Its main limitation is its inability to remain static in the air. The force of gravity is its enemy which compels it to remain in perpetual motion, which reduces its power of carrying weapons of heavy calibre and its protection by armour. The air offers it no protection as water does to the submarine, or earth to the soldier; further than this, when at rest on land, or water, its powers of self-protection are small.

The Harmonisation of the Differences.—Accepting these limitations and many others which space does not permit me examining, their ideal harmonisation would appear to lie in a submersible battleship which can fly through the air and move over the land. Such a vessel, though not totally impracticable, would, if built to-day, be a worthless monstrosity possessing but the minimum power of each arm represented by it, certainly of sea and air, and so would be easily defeated in these two elements. I will, however, accept it as an ultimate goal which possibly may one day be reached, and then see what our immediate steps should be in order to attain it.

Our first difficulty is one of movement. A fleet which possesses command of the sea can normally steam to any point on an enemy's coast line, and effect a surprise before a land force can be assembled to meet it, and this will remain good in spite of the aeroplane; for though the aeroplane may warn the enemy that a fleet is approaching a certain area of the coast, it will be difficult to say for certain opposite what point this fleet will anchor.

On arriving at the point selected, the difficulty begins; the ships cannot crawl on to the land, and the military forces to be landed cannot swim to the shore, and because of these limitations, the means adopted to transfer a muscularly organised army from mechanically propelled ships is little superior to those used by Julius Cæsar, and even more difficult, for his triremes drew very little water. The result of this in the past has frequently been (and in the future will be more so, if the present military organisation is maintained) that all surprise is lost, and that before the army landed can move forward it will be confronted by an enemy in superior strength.

I will now turn to the tank. A floatable machine has been constructed, and though it is still very imperfect in nature, there is no reason to doubt that, in a few years time, a trustworthy one will be produced. From our floating mechanical base, our ships, we launch our floating mechanical army. This force propels itself ashore, crawls up the beach and moves straight inland at a speed of ten miles an hour, and within twenty-four hours of landing is 150 miles within the enemy's territories. Freed from railways, and, I will suppose, possessing one week's radius of action, it can spread havoc in the enemy's country, and, when threatened by a superior force, it can make for the coast line, possibly several hundred miles away from its original point of landing, swim out to the fleet and re-embark.

I will imagine three or four such forces operating at different points against an enemy, and some picture may be formed of the confusion resulting. Then I will suppose that whilst these raiding forces are disorganising the enemy's army, plans and command, as the Vikings disorganised half Europe a thousand years ago, a determined invasion is launched at some vital point; it will be a difficult operation for the enemy to collect his disintegrated forces and meet it, even if these forces be mechanised.

For us *the whole* of such an operation depends on sea-power, the only difference when compared with the past being, that whilst formerly an army, using muscle as its motive force, could seldom make good what the navy rendered possible, a mechanised army can make it good; it can take advantage of a naval surprise, and accentuate this advantage by the speed with which it moves inland.

I will now turn to the aeroplane and continue my speculations. To-day, if an army were landed on an enemy's coast, even if it were but slightly opposed, its progress inland would be very slow. From it aeroplanes would operate forward, but being unable to rest in the air, or to seek rest on the ground within the enemy's country, they would have to return to their all but static base.

Now in place of a static base I will picture a mechanised army moving forward at 100 to 150 miles a day, and it will at once be realized what influence such a possibility will have on the aeroplane. It will possess a moving haven of refuge behind it, it will no longer be necessary for it to return the whole way home, it will be endowed with a greater liberty of action than is possible to-day; in fact, just as a mechanised army can take fuller advantage of naval power than a muscular one, so will the aeroplane be able to take fuller advantage of the power of a mechanised army than it can possibly take in the case of one which for its movement is dependent on human horse-power.

Accepting the above speculations as possible, what have we accomplished? True, we have not reached our ideal—a submarine battleship which can fly and crawl, but by mechanising the Army, the only remaining Service dependent on muscle as a means of movement, we have linked the three Services closer together, and have enabled co-operation between them to become more effective, not only by increasing the speed of the land forces, but by freeing them from the shackles of roads and rails, and so endowing them with a two-dimensional power of movement.

The tank and its progeny, which later may take many forms, ranging from quite small craft equipped with machine-guns, to others carrying the heaviest ordnance, must and will modify our present strategical and tactical doctrines, not only as regards the Army itself, but as regards the Navy and Air Force as well. To-day not only are the Services living in three separated thought-tight compartments, but each Service is struggling with its neighbour to obtain preferential treatment. They are, in fact, cutting each other's throats, not that the fittest may survive, for all three are immortal, but so that each individually may obtain the biggest slice of the Treasury cake. This state of affairs will continue until we have created a body of men who can think in terms of Grand Strategy, the combined use of the three Services in place of their individual employment. This means the fusion of military thought, in the widest meaning of the word military, in one brain, which will not think of the Army without thinking of the Navy, and will not think of either without thinking of the Air Force, and which, further, will know what science and industry are accomplishing in civil life, what politics require, and how to fit all these factors together so that a complete picture may be formed of the necessities and requirements of the next war.

When thinking out these requirements, we must maintain a just balance between the ideal we should aim at, and the means at our disposal. Our means are our present-day Army, Navy and Air Force, our material resources, our national income, and our man-power, and as a revolution in our military organisation is likely to end in chaos, we should, in place, seek to attain our goal through a steady evolution.

Considering the Army alone, this evolution from a muscular to a mechanical basis should, I consider, be attempted in three definite stages:

(i) The replacement of wheeled supply vehicles by cross-country tractors.
(ii) The assistance of present-day arms by mechanising their local transport.
(iii) The gradual replacement of the existing organisation by one based on mechanical movement generally.

As regards the first: a problem which has constantly perplexed commanders in the field is that of the tactical deployment from column of march. Hitherto marches have, normally, been carried out by road, not so much because roads provide the easiest marching surfaces, but because the fighting troops depend for their sustenance on their supply waggons and lorries, and, as these can seldom leave the roads, where they go the troops must follow or precede. Even in spite of this, all immediate necessities have to be carried on the man himself. The result of this to-day is, that a single division marching on the road will require the best part of a day to deploy, and, on account of the 60 lbs. of equipment carried on the man, the troops composing it are normally an exhausted force on the completion of this manœuvre. If, now, we replace the existing wheeled vehicles by cross-country tractors, not only will the length of the road columns be reduced, but these vehicles can, when required, move off the roads and so free them to the troops. Further, they can follow the troops when deployed, and so obviate the present necessity of closing in on roads at the completion of an action.

As regards the second, the assistance of present-day arms, this constitutes a problem which has vexed the minds of Generals quite as persistently as the above one. It pivots on the carriage of necessary fighting equipment and ammunition. Sixty pounds of equipment is not an economical load for a man to carry, and it can never be made an economical load, because human muscular endurance is constant. Further, as warfare evolves, necessities multiply, so much so that, in the recent war, the total weight carried by an infantryman frequently rose to over 70 lbs. in dry weather, increasing to even 100 lbs. in wet. Such weights as these limit the effective radius of action of the infantry soldier to a few miles. Besides equipment, the rate of fire of automatic weapons—light and heavy machine-guns—demands vast supplies of ammunition; if carried on the man he ceases to be a fighter, and becomes but the supplier of another. For one light machine-gun at least four ammunition carriers are required in action; consequently, in place of being a one-man weapon its utility depends on five. If now we supply every platoon of men with one supply tractor and one or two ammunition tractors, not only shall we be able to reduce the weight carried on the foot-soldier by at least 20 lbs. when in action, and 30 lbs. when on the line of march, but we shall be able to increase the number of automatic weapons carried, and so vastly increase the fighting power of the infantry.

As regards the third, the replacement of the existing organisation by a more mobile one, its evolution cannot be other than a gradual one. The artillery horse will, by degrees, give way to the tractor, which will not only transport field and heavier guns, but will enable greater quantities of ammunition to be carried than is possible at present. The tank, from its position amongst the army troops, will, I consider, be called upon to work in closer and closer co-operation with the infantry, as these will require all the protection it can afford them on account of the ever-increasing number of machine-guns rendered possible by cross-country tractors. From army troops the first step, therefore, is likely to be that of divisional troops, and then, as the machine becomes simpler in design, we may expect to see companies of tanks attached to infantry battalions, and eventually platoons of tanks to companies. Later on, if the tank follows in the evolutionary footsteps of the arquebus, musket and rifle, these platoons will grow in strength until the infantry personnel in them will become too small to operate effectively with the mechanical elements. Should such an evolution take place, we may expect to see the future battalion represented by three or four tank companies, equipped with one or more types of machines, and one company of mechanically transported infantry.

The above speculations ultimately lead us to an important question which is likely to be hotly debated in the near future. This is the question of man-power and its place in future wars. In the past man-power has been one of the deciding factors in war, as one man has normally meant one weapon. As it is by means of weapons that blows are given, the more men a nation could put into the field the more weapons could the commander of its army concentrate at the decisive point. Similarly with tanks, it has, quite logically, been urged that, if both sides possess machines of equal power, the side which can maintain the greatest number of tanks in the theatre of war will stand the best chance of winning.[1]

This contention is not disputed, for its correctness is self-evident. The tank in itself is not an economiser of men as men, save in the sense that in battle it protects the soldier better than he can be protected if equipped as an infantryman, or trooper, of to-day; but it is an economiser of human energy, for it enables a man's powers to be expended at a higher profit.

In peace time the size of an army is limited, certainly in civilised states, by the percentage of the national income which can economically be expended on the defence forces as an insurance against war. Supposing that £x is the sum allotted for the cost of the Army, then the object of the military authorities is to obtain from this money, which is largely expended on personnel, the highest rate of interest in terms of efficiency. If, in a present-day army, this efficiency be represented by Y, then the deductions, already drawn from the statistics of the recent war, point to the likelihood of the efficiency of a mechanised army being greater than Y. I will assume that this efficiency is 5Y. Then it would appear that, if we leave out of our account the initial cost of the machines themselves, a mechanised army costing £$\frac{x}{5}$ could replace a present-day army costing £x. Consequently, that £x-$\frac{x}{5}$ will be saved and many thousands of men released for civil employment. This is, however, only true in so far as the shock of battle, fighting efficiency, is concerned. It is, nevertheless, not true when it is realized that wars are not made up only of battles, but include besides the occupation of conquered territories, the garrisoning of defence works, and the supply, repair and training organisations of the fighting troops themselves, the importance of which is likely to grow in direct proportion as the mechanisation of armies renders these armies more and more mobile.

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[1] It should be noted here that the greatest number of tanks need not necessarily be produced by the country possessing the largest population, but rather by the country possessing the superior means of production. Whilst most countries, whatever be their population, can turn out rifles and ammunition rapidly, comparatively few possess extensive means of manufacturing all the components of tanks in bulk.

We thus find that probably the most difficult problem which, sooner or later, will face the General Staffs of all civilised armies, is not the obtaining of increased fighting efficiency out of the sum allotted to them for the personnel they control, but how to divide this sum between the mechanised arms and their administrative services. It is unlikely that this problem will be successfully solved by a hasty change-over urged so frequently by newspaper economists. That it will be solved is a certainty, unless wars cease their troubling, and the most efficient solution to be sought for is, not to turn the present military organisation upside down, but to evolve from out of it, as rapidly as is compatible with the general education of all ranks in the changes in tactics, training and administration which will be demanded, the army of the future. Not an army of machines, but still as ever an army of men, men cunning and skilled in the use of machinery to move them, to protect them, to supply them and to carry for them weapons of increased effect, in order that they may safeguard and enforce that will to win which, as heretofore, must remain the driving power behind every battle.

CHAPTER VII.

THE SECRET OF VICTORY.(1)

> *"Such I hold to be the genuine use of Gunpowder; that it makes all men alike tall. Nay, if thou be cooler, cleverer than I, if thou have more* Mind, *though all but no* Body *whatever, then canst thou kill me first, and art the taller. Hereby at last is the Goliath powerless, and the David resistless; savage Animalism is nothing, inventive Spiritualism is all."*
>
> —THOMAS CARLYLE.

Though the last chapter ended in a human note, it must not be forgotten that men no longer fight with their fists, but with weapons devised by their brains. Before the war, and during it, all armies were paralysed by the idea of mass and numbers. Walls of men rather than the development of weapon-power was the prevailing thought. Strengths were reckoned in sabres and bayonets—the two most primitive and obsolete of weapons. To dislodge this idea of human weight, an idea which throughout the war led to needless loss of life, was essential if the new idea of weapon-efficiency was not altogether to be smothered.

Ars longa vita brevis, is true of all arts save the art of war. The colossal monuments of Egypt, the statues of ancient Greece, the Gothic Cathedrals of the Middle Ages, and the mosques of the Moguls have seldom been equalled, never surpassed, by any modern artist, because art in its essence is founded on the genius of man, and not on the perfection of his tools. Such art is creative, hence its difference to the art of war, which is a destructive craft, dependent on genius true—on the genius of producing tools. And of the soldier "Without tools he is nothing, with tools he is all."

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(1) *Weekly Tank Notes,* 25th January, 1919.

Tools, or weapons, if only the right ones can be discovered, form 99 per cent. of victory; this is the secret which I intended to divulge. Strategy, command, leadership, courage, discipline, supply, organisation and all the moral and physical paraphernalia of war are as nothing to a high superiority of weapons—at most they go to form the 1 per cent. which makes the whole possible. Indeed, " Savage animalism is nothing, inventive spiritualism is all," and it is inventive spiritualism which I will now enquire into.

If the above assertion, that weapons are 99 per cent. of victory, is only half true, then still indeed has a discovery of some importance been made; for given the right tool any war can be won at the smallest cost. The brush of Orpen or the chisel of Rodin differ very little probably from those of Appeles and Praxiteles, and not at all from those of Reynolds and Canova, yet the tactics employed by Marshal Foch differ from those of Napoleon in that his weapons were different, not his genius, or the discipline of his men.

In war, especially in modern wars—wars in which weapons change rapidly, one thing is certain, and this is—that no army of 50 years before any date selected would stand " a dog's chance " against the army existing at this date, not even if it were composed entirely of Winkelrieds and Marshal Neys. Consider the following examples:

(i) Napoleon was an infinitely greater General than Lord Raglan; yet Lord Raglan would, in 1855, have beaten any army Napoleon could have led against him, because Lord Raglan's men were armed with the Minié rifle.

(ii) Eleven years after Inkerman, Moltke would have beaten Lord Raglan's army hollow, not because he was a greater soldier than Lord Raglan, but because his men were armed with the needle gun.

Against the above might be quoted the fact that the superior French Chassepôt in 1870 was beaten by the inferior needle gun; this is true, but it must not be forgotten that the superiority of the Prussian field gun made up and over for any deficiency in rifle fire.

Thus we might continue our comparisons—Lord Roberts in 1900 would have defeated, almost with impunity, any Prussian Army of 1870; and to-day any army of 1919 would defeat an army of equal numbers equipped as armies were in 1914. Only five years separate these two dates, yet the whole craft of war has changed, not because rifles, bayonets, sabres and lances are used differently, but because machine-guns have increased, automatic rifles have been added, tanks have been invented, and aeroplanes have been improved. In fact, the war as waged in August, 1918, is in many respects as different from that of 1914 as the war of 1914 is different from that of 1814.

During the present war we have had a series of vivid pictures thrust under our noses in such rapid succession and so close to our eyes that it is extremely doubtful whether many of us have read aright what they portend, namely—"That it is machine-power and not man-power which wins a war"—inventive spiritualism, in other words: that war is primarily a matter of weapons, and that the side which can improve its weapons most rapidly is the side which is going to win. This was the reason why 59 British Divisions were able to beat 99 German Divisions between 8th August and 11th November, 1918. It was machine-power which rendered this possible; more guns, more ammunition, more aeroplanes and more tanks—the 99 per cent. of victory.

What chance would Alexander have had against Hannibal, or Hannibal against Edward III, or Edward III against Gustavus Adolphus, or Gustavus Adolphus against Frederick? None! Because each of these Generals lacked the superior weapon.

Had Alexander had the slings of Hannibal's Baleares, or Hannibal the bows of Edward's archers, or Edward the matchlocks of Gustavus's arquebusiers, or Gustavus the flintlocks of Frederick's Grenadiers, these Generals would have had an equal chance, for then it would have been a matter of genius and not of weapons. Genius is a gift of God, weapons, the invention of man, consequently, the latter are the easier to improve and to come by. Invention is the line of least resistance, for it can be stimulated by gold and bought; genius can not, consequently weapons form the direction in which victory must be sought.

Had Napoleon at Waterloo possessed a company of Vickers machine-guns he would have beaten Wellington, Blücher and Schwartzenburg combined, as completely as Lord Kitchener beat the Soudanese at Omdurman; it would have been another "massacre of the innocents." Not having such a weapon all his genius was insufficient to prevent his army being overwhelmed by "savage animalism." Had his men been only armed with the Minié rifle, a muzzle-loading weapon, he still must have won, for it outranged the flintlock by 600 yards.

But how could Napoleon have had either of these weapons, for they were not invented in his day, they did not exist? This is the very point which requires a prodigious accentuation. Foresight creates demand, demand creates supply. Berthier was a supreme clerk, but he was not what every Chief of the General Staff should be —a mechanical clairvoyant, a seer of new conditions, new fields of war to exploit, and new tools which will assist in their exploitation. Had Napoleon, or Berthier, in 1805 placed down as a challenge to the mechanical intellect of France 25,000,000 francs to produce a weapon 100 per cent. more efficient than the "Brown Bess" it is almost a certainty that by 1815 he would have got it; that he would have won Waterloo, and that the whole course of history would have been changed. How easy and simple it is to write a cheque, how difficult to become a supreme clerk.

Jomini, writing a little after this time, mentions the invention of a machine-gun of considerable power; he does not, however, mention that any soldier asked for it. In this connection it will be remembered that Wellington considered that the Brown Bess could not be improved upon, and that later on William Napier was averse to the introduction of the Minié rifle, because he was of opinion that the increased range it gave would destroy the infantry spirit by turning infantry into "long ranged assassins."

If there is wisdom to be learned from this let us grasp it. Without an incentive improvement is slow, with it it is fast, and it is gold which sets the pace—it is the calomel of invention.

Before the present war it was the *Daily Mail* which offered £10,000 to the first man who succeeded in flying the Channel; it was not the War Office or Admiralty which did so, and yet the aeroplane is, and was, of far greater importane to the soldier and sailor than to the journalist. In a few weeks the prize was won—herein is a great military lesson: If an adequate reward is offered an adequate weapon will be supplied, almost forthwith.

For several years before the present war, an interminable wrangle took place over the trajectories of old and new rifles; yet no attempt was made to increase in number the two machine-guns with each battalion, and one Maxim gun was worth 50 to 100 rifles, and any curve of trajectory. Such military scholasticism would have been impossible had we possessed a scientific

General Staff, that is a war-tool-thinking body of men.

In 1888, a tank to all intents and purposes, was designed. What did the soldier do, what did he know about it? Nothing! He was content, quite content, with the Martini Henry, it had proved an excellent weapon for exterminating blacks, he was content to leave all improvements in weapons in the hands of a few civilians—military philanthropists—who have generally had the greatest difficulty in getting any new or improved weapon adopted—soldiers dislike charity.

To-day we stand on the threshold of a new epoch in the history of war—the petrol age. Now that the war is ended, are we going to content ourselves with the old unscientific methods of 1914? Are we going to hark back to civilian foundling hospitals? Are we going to wrangle about rifle trajectories and count our strength in bayonets and sabres? Are we going to write new "Rules and Regulations" in best Dundas style, and refuse to accept the outstanding lesson of the 4,000 years of the known history of war, namely, that: War is a matter of tools, and the highest mechanical weapon nearly always wins.

In 1888 the design of the tank existed, in 1918, thirty years later, the tank proved the decisive weapon in the greatest war in all history. Had the War Office in 1888 been mechanically clairvoyant, had it offered £1,000,000 as a prize for the best military machine, it would have got it years and years before 1914; the idea existed, but the incentive was lacking.

And what do weapons depend on? Design; and design depends on "brain-waves" and auriferous stimulants. If to-day we want a tank to cross water, it is a very long process, and a wrong one, to wait until some benevolent civilian, after much toil, forces one down our throats like a nasty medicine. Why not instead resort once again to the cheque-book, that "Open Sesame" to all improvement; why not offer £1,000,000 for it? it will be cheap at the price.

Design depends on designers. We have Sandhurst and Woolwich, Ordnance Colleges and Staff Colleges, and many minor educational institutions; but we have no great design school, a school which will weigh the past of weapons and forecast their future, and yet design represents 99 per cent. of victory.

Though design does not depend entirely on money, it is intimately connected with it, just as surgery is. No man willingly goes to a 2/6-a-visit doctor to have his leg off; because the usual run of 2/6-a-visit doctors are worth to a farthing what they charge. You cannot expect to obtain a first-class tank if you pay your chief designer £750 a year; but you may expect a good one if you add another nought to this figure.

What we now want is a cheap army, economical in man-power, *i.e.,* a mechanical army, and the way to get it is to have:

(i) A thinking clairvoyant General Staff.

(ii) The highest grade designers.

Both must be highly paid, for money is not only the token of worth but the incentive to work, it is the golden spur of all progress.

In the past the General Staff has dealt chiefly with military metaphysics, in future it will have to deal mainly with military mechanics. In the past a staff officer graduate examined in microscopic detail Jackson's Valley Campaign. Most interesting, but scarcely sufficient; for in future he will have to examine the foundations of victory from the days of Rameses II to those of Marshal Foch. As regards tools he will have to know what the Sarissa meant to Alexander's hoplites; why the Roman legionaries disappeared before the francisca and the Gothic lance; how it was that armour reinstituted cavalry and rendered infantry for the time being obsolete; why it was that gunpowder was the creator of manœuvre and the reintroducer of the spade; and how it was that petrol, a fluid, restricted gunpowder, a solid. He must study the Scottish Acts of Parliament of the 15th century regarding war-carts, and the Chinese tactics as to the manœuvre of machines very similar to tanks, many hundreds of years B.C. He must study both modern engineering journals, and the old prints of hundreds of years ago depicting flamenwerfers and gas bombs; these will set vibrating brain-waves which will awaken new design. He must study the evolution of weapons, in fact, he must become an adept in war tool biology.

This is scientific preparation for war, the rest is 1 per cent. A million or two spent yearly on this is a little matter, when a war between two opposing nations similarly armed costs £8,000,000,000, even to the winner.

Had Napoleon had a company of Vickers machine-guns at Waterloo he would have won that battle; had we in 1914 had tanks we should have won this war four years earlier. If, in 19—, or whenever the next war breaks out, we possess a weapon, not millions of times superior to the enemy's as the Vickers machine-gun is when compared to the musket of 1815, but say, 500 per cent. superior, we shall win that war in a fortnight. Had we done so before this war we should probably have saved 600,000 lives and £7,000,000,000 in money. This sum, at 5 per cent. represents £350,000,000 a year; a million or two spent yearly on the design of tanks alone, in place of, say, £100,000, would not appear to be either an extravagant or uneconomical investment.

CHAPTER VIII.

THE DEVELOPMENT OF SCIENTIFIC WARFARE.(1)

Once it is realised that the future of war pivots not on muscle, but on intelligence, and on the weapons and means of war which intelligence creates, then a stupendous vista of possibilities is opened before us. Standing on this mountain top uncramped by the restricted distances of the valleys we have left behind, we can see, even though dimly, a future to war very different from its past. Then looking back we perceive that what lies before us is not a sudden revolution, but the culmination of a slow, but certain, evolution which for centuries has been unconsciously taking form. Realising this, we can establish a rational base to our speculations. To the uninitiated they may appear fantastic, yet when it is realised that every new machine and invention is but an extension of the native powers of man, then it would appear that no rational thought is impossible. This is the thesis of this chapter.

1. *The Great War.*

My intention in this paper is to examine the purpose of war from its philosophical rather than from its traditional aspect. I shall, therefore, attempt to probe beneath the human sentiments and emotions which obscure and confuse its aim, and apply the cold touch-stone of reason in my search after that quality called truth. Though I do so, it must not for a moment be supposed that I under-rate the importance of the emotional side of war, but I feel that in spite of the causes of war being closely connected with the primitive instincts and impulses of man, and in spite of war itself being pre-eminently a psychological struggle, neither can the causes of war be restricted nor can this struggle be directed economically unless the purpose of war is reduced to a rational conceit of the main purpose of all life which is to live.

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(1) *Lecture to the R.A.F. Staff College,* June, 1923.

Without entering into the details of history which are accessible to all, if we examine war, and especially modern warfare, we shall find that its object is the security and development of national policy, the defence of which is the undoubted right of nations. Here we find two purposes: one in nature defensive and the other offensive; in the first an attempt is made to preserve what a nation already possesses, and in the second the attempt is to modify foreign policies so that the policy of the nation concerned may expand.

In order to understand what these purposes entail, it is necessary to realize what the policy of a country includes, and by policy I mean the foundations of its existence as a free self-governing community, and not the ever-changing items of politics which so frequently are confused with this issue.

The main purpose of a nation is prosperous racial survival, and to all individual and family requirements must be added the need of co-operation between individuals and families as well as the self-sacrifice of these for the common or co-operative good. For a nation to survive it requires:

(i) Competition leading to commercial prosperity.
(ii) Self-sacrifice leading to ethical superiority.

(iii) Co-operation leading to social stability.
(iv) Militarism leading to national security.

If the purpose of military force is to secure policy, then it stands to reason that military action must not prove detrimental to policy, or, if this be impossible, then the less this action does prove detrimental the closer will it be in accordance with the aims of policy, for war is in essence but a continuation of policy by force in place of by argument; it is a means towards an end and not the end itself. Being a continuation of policy, it logically follows that the termination of a war should be followed by a state of peacefulness in which the policy of the victor is in every way more prosperous economically, ethically and socially than it was the day war was declared.

In order to realize the influence of this correlationship on the tendencies of future warfare, it is necessary to examine the modes through which wars in the past have evolved. It will then be seen that, though the means and organisation of war have frequently varied, the true object of the soldier, though more often than not hidden, even from his own understanding, has remained constant.

In primitive times every male was an armed man, that is, an individual soldier, and society was based on what may be described as latent anarchy. Later, as nations arose, anarchy gave place to collective rule, and domestic tranquillity was founded on military force, which, to-day, in all civilised countries, is represented by a police force and an army. Once domestic peacefulness was assured, in order to secure the nation against foreign aggression, a reversion to the primitive state took place, so that the maximum man-power could be developed collectively, collective action securing the nation not only against civil war but against invasion and hostile diplomacy.

In primitive times the military object of the armed man was primarily economic, a search after material prosperity, but also was it ethical in that it secured the individual rights of the armed man and of his family. In the second stage the object was primarily social—the maintenance of law and order—and it was ethical in that it maintained the liberties of the communities of the nation. In the third stage it was primarily ethical in that it maintained the liberty of the nation as a whole, also was it economic, for it secured national prosperity, and at times enhanced it by conquest.

It will be seen that all these modes of war secure prosperity and liberty, and that, in organised states, to these two must be added another quality—fraternity, or domestic order. Consequently, it follows, if the object of one army is to protect these essential national qualities, the obverse of this object is to atack these qualities in its enemy's national organisation in order to compel the enemy to change, abandon, or modify his policy according to the will of his adversary.

In order to accomplish this change in the will of a nation, it is first necessary to penetrate the enemy's naval and military defences. In the past the means most generally used has been slaughter, hence it has arisen that a false object has been created in war, the means have been mistaken for the end, the means being death and destruction, the end being life and a more prosperous existence.

As long as nations were of rudimentary organisation, and armies numerous and small, it made very little difference economically to the world, if, now and again, one side or the other was exterminated. Further still, as foreign trade was based mainly on an exchange of luxuries, all nations being self-supporting as regards necessities, the destruction of one nation's prosperity had little effect on the prosperity of its friends or enemies. To-day, however, nations are closely inter-knit, and their respective prosperities are so intimately interwoven that any economic loss on the part of one nation is a common loss to all nations of the civilised world including the nation which though victor has effected this loss.

In August, 1914, we went to war with Germany in order to maintain a policy, the foundations of which were our national existence. Had it been possible for us by some magical means immediately to have destroyed 5,000,000 German soldiers, should we have maintained this policy? In so far as its foundations were concerned, "yes," but in so far as it concerns the edifice of prosperity raised on these foundations the answer is emphatically "no!" And why? Because by killing 5,000,000 German males, simultaneously we should have reduced the economic strength of the German nation, and, consequently, have debilitated a market, which, prior to the outbreak of the war, was worth approximately £100,000,000 sterling to Great Britain. What does this mean? It means that though such an action as the above may have been at the time in question the best of possible actions, yet within it exists ample room for improvement, for had it been feasible by yet some other magical means to have compelled Germany to disarm and disband her 5,000,000 soldiers without destroying one of them, then visibly our policy would have been more fully maintained, since our prosperity of 1914 would have been enormously secured.

If we examine the history of the war, we shall frequently find that, besides the direct military attack on an enemy's army, the enforcement of policy has been attempted by an attack on his economic resources. In place of striking directly at the hostile army, blows have been directed against the stomach of the hostile nation which this army protects. Again, if carried to its extreme, that is, the surrender of a nation through starvation, or the direct destruction of national resources as typified in manufacture and commerce, do these means enforce policy? The answer is as above, "yes," so far as national existence is concerned, and "no" so far as national prosperity is in question. Because, by destroying the enemy's resources and debilitating his people we are economically, and in this case also ethically, striking a blow, not only against ourselves, but against the whole civilised world. To-day such blows may be inevitable, but, as I will show, they appear to be unnecessary in the future.

If we now pause for a moment and think deeply, we shall realize that both the above means of maintaining, or enforcing, a policy are but means of attacking the will or nerves of our antagonist. In the first case, the enemy's will to persist is destroyed through the destruction of his army by physical attack; in the second, this will to persist is destroyed by economic attack, and with the destruction of this will is the power of the hostile army reduced to zero. In both cases we see, therefore, that the true object of war is the demoralisation of the enemy's will, for on this will is his policy founded. Once this will is broken down a policy can be enforced, and as long as it exists a policy can be maintained. If this is the true object in war, then it logically follows that all our means, military or civil, should be directed towards its attainment, bearing always in mind that in its attainment our own prosperity must not be reduced or our ethics dishonoured.

To summarise, war in its philosophical form is a struggle of two wills in opposition. Each of these wills is protected by economic resources, ethical codes, social rights and military forces. This will may be attacked in four ways, singly or combined: by physical attack, economic attack, social attack and moral attack. The first is directed against its military strength, the second against its commerce and industry, the third against its politics and domestic tranquillity, and the fourth against its will and nerves. Of all the means of attaining the object, the first is the least and the last the most direct. To illustrate this I will now trace the evolution of my theory by examining the tendencies of the recent war.

Ever since 1866 and 1870, the eyes of the General Staffs of Europe had been blinded by the brilliance of Moltke's strategy. Soldiers had gazed on the bayonet points of Sadowa and Sedan until they were hypnotised by these great battles, and under the influence of this hypnosis they dreamt of the next war as an immense 1870 operation, involving unlimited slaughter.

This doctrine was based on two tremendous fallacies: First, that policy is best enforced by destruction; secondly, that military perfection is based on numbers of soldiers. Not realizing the vast changes in science, or the stupendous change in conditions which would surround the next war, and meditating on war as a thing in itself, as an end rather than as a means towards an end, the General Staffs of Europe calculated the strengths of their respective armies in tons of human flesh. Then, after fearful slaughter, these directors of war began to realize that war is a living art, a system of knowledge and action which must be fed on the civil sciences and nurtured on the civil industries in order to maintain its strength and purpose—the enforcement of a nation's policy with the least detriment to the peace which must follow final victory.

Whilst, prior to the war, in the great armies of the world, we find man-power obliterating tactics, so in the great navies do we find machine-power doing exactly the same thing. Men and more men, battleships and more battleships, but how these men or battleships should fight or be fought, and what influences the inventions of the last forty years would have on tactics was not even imagined. On land soldiers were expected to fight much as they fought in 1870, and at sea sailors would fight much as they fought in 1805. Such was the position in 1914.

Thus we find, when we examine the opening phases of the Great War, that traditionally educated and trained armies and navies have but one chance of success, that is, the initial operation they undertake; that success being based on the fact that as their opponents may also be tradition-bound, their own tradition may triumph over that of their adversary's. Also, we see that, if the initial clash of arms does not result in victory, at once the influence of weapons, means of movement and protection, which have been designed since these traditions became stabilised in blind custom and routine, exert their sway and bring traditional warfare to an end, and out of the knowledge gained from these new means, slowly evolves a new doctrine which replaces the old dogma.

After a few weeks of *real* warfare, the *offensive à outrance,* that high gospel of the pre-war manuals, was reduced to a wallowing defensive among mud holes and barbed wire. Armies, through their own lack of foresight, were reduced to the position of human cattle. They browsed behind their fences and on occasion snorted and bellowed at each other. The one problem which now confronted them was: how to re-establish movement, for until one or both sides could move, there was no possibility of a decision by arms, and famine alone must become the arbiter of victory. Some there were who actually recommended this course, but their voices were drowned by shouts for shells. Shells were to be the panacea of all difficulties, more shells and still more shells, and then by steel a road could be blasted to Paris or Berlin. A veritable blood and iron lust swept over the armies of Europe.

There were two visible reasons why this monstrous attack by shells was doomed to failure: First it destroyed all forward communications; roads vanished, tracks vanished, railways vanished, and the surface of the ground vanished under the influence of the material earthquakes to which all things were subjected. Secondly, bombardments lasting from seven to twenty-one days in duration rendered any form of surprise impossible. When a big game hunter visits East Africa to shoot lions, he does not equip himself with a bassoon, and then, when a lion is met with, walk round the beast for a fortnight playing on this instrument. He does not thus comport himself since all idea of surprise would vanish, and so also would the lion. Unfortunately, a staunch and determined enemy does not behave himself like a wild animal; in place of bolting from the bassoon, he assembles his forces opposite the spot which is being, like Jericho, trumpeted to earth, and when the attack is well bogged in the slough created by gun-fire, attacks in his turn.

The enormous demands made for all types of munitions of war and warlike supplies brought into a clear light those economic foundations of the war which, in peace time, had lain too deep to be noticed much by soldiers. First, these munitions had to be supplied; secondly, their supply curtailed the manufacture of luxuries as well as many every-day necessities. So visible did these economic foundations become, that it was not long before the General Staff of the contending nations realized that, if the food supply of the enemy could be cut off, the will of the civil population would be undermined, and with this loss of will to endure, their military forces would be rendered useless.

The first military problem of the Allies now became that of the circumvallation of the Central Powers; the second problem, their surrender by starvation. Consequently, during this phase of the war, the problem of re-establishing tactical mobility was to a certain extent replaced by a direct attack on the enemy's stomach.

The encirclement of the Central Powers by the Allies resulted in the most gigantic siege in history, in which the British Navy was called upon to play a prominent part. When, however, the blockade began to tighten, Germany had no intention of committing suicide, she was fighting for her life, and not being able to hit above the belt, she hit below it in order to make good by cunning, her physical naval deficit. The result of this was that she launched her unrestricted submarine campaign, and was, consequently, outlawed.

The underlying factor throughout the whole of this period of the economic attack was that, as the fighting forces are maintained by the country to which they belong, they can, under modern conditions, be attacked indirectly by the delivery of a direct attack on the nation itself. Siege warfare nearly always demands a costly process of attrition, and never more so than when an entire nation has to be besieged and starved into submission. I will now show that, towards the end of the Great War, a more economical method of attack was taking form, a method which, in the future, may compel an entire nation to throw up its hands and crave peace within a few days, possibly hours, of a war being declared.

In the past, as I have attempted to show, the theory underlying war was that of enforcing policy by destruction of life and of property; in the future I believe this indirect attack on the will of a nation by striking at his body and stomach will be replaced by a direct attack on his nerves. To realize why this should be, it must be remembered that national wars are but correlatives of modern civilisation, which, since the introduction of steam-power, especially in the form of the steamship and locomotive, has completely revolutionised society. With the adoption of steam as a motive force, we see introduced simultaneously a physical world contraction and an intellectual world expansion. Whilst, in the year 1800, the nervous system of a civilised nation was of a low and ganglionic order, by 1900 it had become highly sensitive and centralised, in fact, so much so that every civilised nation offered to its enemies an extensive moral target which, if attacked, was likely to lead to a complete paralysation of the national will. The only outstanding difficulty in this attack was that the traditional weapons of war were not suited to operate directly against this target.

In traditional warfare, it was the rule that armies attacked armies and not non-combatants. If this tradition were strictly adhered to, then the demoralisation of the enemy could only be effected by the destruction of the enemy's army and fleet. This process proved a most bloody one, and, during the war, adherence to it resulted in appalling slaughter. It should here be once again remembered that the more bloodless a war is the more prosperous and contented will the peace which follows the war normally be for all concerned. For example, if, during the recent war, Germany could have been forced to disband her army and scrap her navy by a sudden and enormous loss of national *moral,* which entailed little bloodshed and small damage of her industries, would not the world to-day be a more prosperous and contented habitation than it actually is? There can be no two answers to this question, even if in the process a few thousand German women and children had been killed.

I will now turn back to the Great War and examine certain means of warfare, the future development of which I believe will, whilst minimising bloodshed and ruin, prove adequate in order to enforce policy.

On April 22, 1915, the Germans first made use of gas as a weapon on the Western Front, and inaugurated a mode of warfare which I am of opinion is destined to revolutionise the whole art. They made, however, two cardinal mistakes: first, they used lethal gas which was unnecessary, and secondly, they did not use sufficient of it for the winning of a decisive battle.

The effect, though restricted, was appalling, consequently, tradition was shocked to the marrow, and, without doubt, the whole civilised world shuddered with horror, and gas, like gun-powder, chloroform and the locomotive, was pronounced to be the invention of the devil.

The horrors of gas warfare have been so well advertised that the very enthusiasm shown by its execrators should make us pause and think. What are the facts? In the American Army they were as follows:

The total number of casualties resulting from all causes was 274,217. Of these 74,779, or 27.3 per cent. were due to gas. Of the gas casualties only 1,400 or 1.87 per cent. resulted in death. Of the remaining 199,438 casualties, resulting from bullets, shell fire, etc., 46,659, or 23.4 per cent. proved fatal. In fact, gas is twelve times as humane as bullets and high explosives!

The true value of gas as a weapon only became manifest, and then but to a few, when, in July, 1917, the Germans disclosed the immense possibilities of chemical warfare by making use of a substance commonly known as mustard gas. Respirators to a great extent were useless, for the persistent and vesicant nature of this chemical rendered whole areas, for days on end, uninhabitable and dangerous to cross. Few died from its effects, but many were incapacitated for months on end.

Here, curious to relate, is to be discovered the true power of gas as a weapon—*it can incapacitate without killing*. A dead man says nothing, and when once buried, is no encumbrance to the survivors. A wounded man will spread the wildest of rumours, will exaggerate dangers, foster panic and requires the attention of others to heal him—until he dies or is cured, he is a military encumbrance and a demoralising agent. Gas, as I will show later on, is *par excellence* the weapon of demoralisation, and, as it can terrorise without necessarily killing, more than any other weapon, it can enforce economically the policy of one nation on another.

I will now turn to air warfare.

At first but a mere adjunct of the older arms on land and sea, within three years of the outbreak of the war, the aeroplane had all but won its independence, for not only could it hop over armies and fleets and attack the brains of these forces, but it could attack the *moral* of the government defended by these forces, above all the will of the nation upon which the power of government is founded.

As it cannot be more immoral to bomb a town than to bombard it, does the immorality of an aeroplane attack lie in the fact that, whilst in a bombardment the slaughter of women and children is but an unfortunate incident, in an aerial attack on a town the terrorisation of its civil inhabitants becomes the main object? I believe that this is the popular conception, simply because the people have not yet grasped the fact that when nations go to war the entire population of each nation concerned is ranged against the other, and that the solidarity of their fighting forces is founded on the civil will.

Apparent as this fact is, it was only towards the end of the Great War that the various belligerents began to realize what an attack on the civil nerve centres really meant. Simultaneously, they also learnt that if the body of an army were attacked by low-flying aeroplanes it was all but helpless. In Palestine and Syria the routed Turks suffered seriously from this form of attack, so also did the retiring Austrians in Italy.

I will now examine a third means.

For many years before the outbreak of the Great War the line along which tactical power had been sought was fire, more fire, and yet more fire. Protection, except by fire, and by extensions, that is, by reduction in the size of the target, had been neglected, and increased means of mobility, except for the railway, had scarcely been considered at all. In 1914 (and for all that still to-day) the marching-power of the soldier was about the same as it was in the days of Cheops and Sennacherib.

As the type of fire aimed at was rifle-fire, and as it was well known that a rifle bullet could be rendered perfectly harmless by about 8 m.m. of armour, it was truly astonishing, when to-day we look back on the problem, that before the outbreak of the war no single soldier of note thought of using the petrol engine and chain track for the purpose of carrying armour in order to protect human flesh.

Immediately traditional methods of warfare had broken down in September, 1914, the idea of an armoured caterpillar machine arose, and two years later it materialised in the tank which was first made use of on the battlefield of the Somme on September 15, 1916. From this date on to the battle of Hamel, July 4, 1918, British tanks had to fight for their existence, not against the enemy's opposition, but against tradition, and so well did they fight that, in 1921, General von Zwehl was able to write: "It was not the genius of Marshal Foch that defeated us, but 'General Tank'."

I do not propose here to discuss what tanks accomplished, in place I will show that by degrees it became apparent that against traditionally organised armies the main power of this machine did not lie in its destructive capacity, but in its ability to attack the nerves and will-power of armies.

In June, 1917, the British Tank Corps proposed, in place of attacking the enemy's front, to attack his rear by passing large tanks, carrying within them, besides their crews, 20 machine-gunners with four machine-guns, through the enemy's front and depositing them in rear of it. By so doing they would cut off this front from its reserves and communications; they would, in fact, attack the morally weakest point in the enemy's battle body, and, in May, 1918, this idea was replaced by that of a direct attack on the enemy's brain and stomach—his command and supply system, as already described in Chapter IV.

Though fate was to decide that this attack was not to take place, since hostilities terminated in November, 1918, it is interesting to note the following evolution: that the war opened with traditional warfare; that the underlying idea of all traditional operations is killing; that by degrees this idea gave way to that of demoralising, until, finally, a method of attack was devised which all but ignored brute force, and which for slaughter substituted nervous shock, aiming a moral blow at the brain in place of a physical blow at the body of the enemy's army.

2. *The Future.*

Having now shown that the tactical tendency in modern warfare is to strike at the *moral* rather than at the muscle of an enemy, in the second half of this paper it is my intention to follow this tendency into the future, and to examine the probable influence of four new means of war, namely, gas, the aeroplane, the tank and the submarine, on the warfare of to-morrow. The first, in my opinion, is the weapon of the future, the remaining three being means of carrying and projecting this and other weapons.

First of all I will ask this question—what is a weapon? A weapon is a means of imposing a policy upon an adversary—it is a lethal argument. The policy of a nation, as I have explained, should be enforced with the least loss possible to either side in particular, and to the world in general. The less the loss, the better will the policy enforced flourish. The security of peaceful prosperity is the object of war, not slaughter. A weapon should, therefore, possess the following characteristics:

(i) Its production should not detrimentally affect prosperity.
(ii) It should be simple to manufacture in peace and war.
(iii) Its nature should be unknown to the enemy.
(iv) It should economise time on the battlefield.
(v) It should incapacitate without killing.
(vi) It should permit of an antidote being known.
(vii) It should effect no permanent damage to property.

The weapons of traditional warfare do not permit of these characteristics being developed, as they are all designed to fulfil the idea of physical destruction. I will now show how gas will revolutionise this idea.

(i) *Economy in Production.*—Gas, unlike traditional weapons, is an article of commerce, and most of the gases employed during the Great War were manufactured not only by the normal chemical processes, but from chemicals in everyday use. Consequently we see that, in gases and war chemicals, we possess not only a means of securing national prosperity, but also a means of fostering it. This in itself constitutes a stupendous economic revolution. To-day, Germany possesses 70 per cent. of the organic chemical output of the entire world, and can use this output for war. Great Britain possesses 11 per cent., consequently, Germany to-day, in spite of the treaty of Versailles, is in possession of gas supremacy. Should not we, therefore, do our utmost to foster organic chemistry at home, yet how can we create the necessary supply unless we establish a demand for it? If gas becomes our predominant weapon, then a demand for it will be created, and in seeking for new war gases we shall undoubtedly discover chemicals of great commercial utility.

(ii) *Simplicity of Manufacture.*—Simplicity in manufacture of weapons during wartime is frequently a synonym of victory. For any weapon to be manufactured rapidly, it is necessary to have its components at hand. If a country cannot produce them, then, in any crisis, it may suffer from a weapon famine. What is the main source of chemical warfare? Coal—coal-tar and oil—from which also most of the medicines and dyes of the world are produced. In Great Britain we possess vast resources of coal, consequently, for chemical warfare supplies we are not dependent on foreign products. Not only is it unnecessary for us to obtain from abroad our raw material for weapons, but, in place of spending our money on foreign nitrates, we can spend it on home-mined coal. Germany is also a great coal producing country; if in another war, as in the last, she loses her command of the sea, is it humanly likely that she will placidly accept defeat because of a shortage of traditional weapons when gigantic resources for the production of chemical warfare are actually but a few yards under her feet?

(iii) *Secrecy of Nature.* — Secrecy in the nature of weapons is the foundation of tactical surprise, and surprise is the most economical principle whereon to build grand tactics. In war, surprise is the pivot of victory. In the past the brute force theory of warfare has to a great extent been foisted on to the armies and navies of civilised nations on account of their inability to keep their weapons secret.

It is not practically possible to keep a bullet or shell secret. It is, however, possible to keep the contents of a shell secret. A new explosive may be discovered and may be kept secret, but in effect it will only be a modification of an existing means of destruction. A new gas may, however, be kept an absolute secret, and what is equally important, its antidote may be kept secret as well.

(iv) *Economy of Time.*—As regards weapons, time, in its military sense, is a correlative of effect. Thus the speed of fire is useless if the projectiles are ineffective. With gas the actual rate of fire may be slower than that of traditional missiles, but if volume of fire is considered it will at once become apparent that no traditional weapon possesses this quality to the extent of gas. From a machine-gun 600 bullets can be fired in a minute, but gas is composed of chemical molecules, consequently, the projectiles of a gas bombardment cannot be reckoned by hundreds a minute, but by thousands of trillions. In fact, so immense a number, that it is not even necessary to know the position of the target, all that is necessary being to know in what area it is, and then to inundate it.

(vi) *Economy of Life.*—Lethal gases were largely used during the Great War, and yet, as I have shown, fatal gas casualties were few. There is, however, no reason why lethal gases should be used, since non-lethal chemicals are still more effective. If the statistics of the total casualties of the Great War are examined, it will be found that by far the greatest number of casualties were suffered by infantry and caused by infantry weapons. If infantry could be abolished casualties would be reduced in number. Gas can effect this abolition as it is manifestly impossible to protect infantry against all forms of gases, for to do so infantry would have to don divers' suits, and would become totally immobile.

There are two further reasons why gas will economise life. First, if gas becomes a universal weapon, the result will be a universal type of casualty, and, consequently, simplification in medical work. Secondly, as the nature of new gases can be kept secret, surprise in war will become more frequent, and, consequently, the winning of victories will be speeded up. The shorter the war the less, normally, is the loss resulting.

(vi) *Assurance of an Antidote.*—In traditional warfare the only universal antidote to being killed is to kill, hence its barbarous and blood-thirsty nature. From time to time means have been sought in order to reduce the casualties—such as body armour, helmets, shields and entrenchments. Gas is, however, unlike all traditional weapons in that, if a new gas be discovered, immediately an antidote can be provided for it. Consequently, it is now possible to send men into battle equipped with weapons against which the enemy may possess no protection, whilst our own men are completely immune.

(vii) *Economy of Property.*—As the object in war is to guarantee and safeguard prosperity, destruction, even of the enemy's property, should be avoided. In modern warfare the means of destruction have become so great that no nation considers its frontiers safe unless it possesses an army sufficiently powerful to destroy the enemy before the enemy can destroy it. The horror of the results of invasion was one of the causes, not only of the Great War, but of the armed peace which preceded its outbreak. Substitute gas warfare for high explosive warfare and a remedy presents itself.

In order that gas may become a universal weapon, a universal means of military movement is required. In the past, the motive force of armies has been muscular, and muscular power being in nature very limited has in its turn restricted the power of weapons and resulted in a great variety of types, each attempting to make good certain deficiencies in the other.

To-day, we possess an all but universal means of movement — the petrol engine, which will influence land weapons as it is to-day influencing air weapons, and as steam has and is influencing naval weapons.

Though the power of three dimensional movement by aircraft is generally recognised, the influence of this power in the future of warfare is in continual dispute, because, so I believe, we have not yet learnt to think of war from its third dimensional aspect.

As the powers of aircraft include the dimensions of movement made use of by armies and fleets, it stands to reason that, of the three great defence forces of civilised nations, the air force is the only one which can closely and continually co-operate with the other two. On account of this ability to co-operate, that is, to move with armies or navies and yet independently of them, we are faced by the following portentous strategical problem: May not the power of aerial co-operation become so perfect that in place of aircraft co-operating with navies and armies, these forces will instead co-operate with aircraft, and that possibly, at some date in the future, the utility of armies and navies will be reduced to zero, aircraft entirely replacing them. I will now examine this problem under three sub-headings:

(i) *The Influence of Aircraft on Land Warfare.* —In the next great war capture of the air will become of supreme importance, because, of all tactical "positions," the air is the one which controls all others. Once this supreme point of vantage is gained, the next tactical operation will be to deliver an aerial attack on the land forces, not only on their bodies, but on their brains, on their nerves and on their internal organs.

If traditional weapons are used, in order to attack the land forces, aeroplanes must fly low, and so tactically be placed at a disadvantage to high-flying hostile aircraft. It is more than likely that twenty low-flying aeroplanes, mounting several machine-guns apiece, could destroy an entire infantry division in column of march. But why destroy and why fly low when gas as a weapon will enable aircraft to fly high and so incapacitate without killing? Twenty aeroplanes fitted with tanks of liquid gas could pour into the air a rain of gas which, as it descended, would atomise and form a great cloud which would roll over the scattered and unseen target below, and throw an army into "a mystic sleep." What general on earth is going to win decisive battles, battles which need the most careful assembly and speedy concentration of troops, if whole divisions and army corps are going to be put to bed for several hours on end, two or three times a day? Consequently, traditional infantry, the greatest slaughterers of all, have no place on the future battlefield, not because they are harmless, but because they are absurd!

(ii) *The Influence of Aircraft on Sea Warfare.* —What does the traditional naval attack entail? —slaughter in an accentuated form. On land military units are seldom exterminated, at sea the extermination by drowning of entire ships' crews is the rule and not the exception. To-day, we hear much concerning the aerial bombardment of battleships, but why bombard these vessels with one-ton bombs, a difficult operation, when they can far more easily be drenched with non-lethal persistent gases? A Dreadnought drenched with a colic-producing chemical might be rendered so inoperative that, in half an hour after the attack is launched, she might be boarded by the crew of a rowing boat. To protect herself the Dreadnought must become airtight, and not only does this present immense difficulties, but it is likely to render her an easy target to submarine attack, for when airtight her fighting powers will be greatly reduced.

(iii) *The Independent Action of Aircraft.*—I have already hinted at the possibility that, in the future, air forces may replace armies and navies. Actual replacement is, in my opinion, a misconception of the object in war. Armies and navies are lethal instruments of security, but the true object is not to kill soldiers or to sink ships, but to change a policy which these soldiers and ships are protecting. If, in the event of war, an air force can change this policy with less physical destruction than it has been possible to attain by armies and navies in the past, then the air force will not absorb the military purpose of navies and armies which in nature is tactical, but will instead establish a new conception of war, a conception in which naval and military forces will have either no place at all or one which is subordinate to their present purpose, and by subordinate I mean the occupation of land and sea *after a moral victory has been won on land by aircraft.*

For the aeroplane, what are the main joints in the harness of present-day armies? They are: the enormous targets they offer; the vulnerability of men and horses to bullets and gas; the slowness of their movements and the dependence of their supplies on roads, rivers, railways and canals—fixed communications which from the air can be followed with ease.

If land forces are to be maintained, what have we got to do? We must reduce the target, that is, we must make it so small that the aeroplane is forced to fly at low altitudes in order to discover it. But, say you: It need not do so because gas is an area and not a target hitter. Well then, we must completely protect our land forces against this weapon, and compel the aeroplane to risk flying at low altitudes which will demand the replacement of gas by bullets. Consequently, we must protect our troops from bullets as well. Further, we must enormously increase the speed of our troops, and we must free ourselves from roads and railways, the traditional means of movement, and move over areas, that is, straight across country, like ships over the sea.

Are these problems impossible? Far from it, for the tank, and especially the tank of the future, solves them all!

(i) It reduces the target, for it does away with great march columns and immense battle formations.
(ii) It can be made gas tight, so completely that even unknown gases will lose their dread.
(iii) It can be made bullet-proof, even against bullets of enormously enhanced powers.
(iv) It can be made to move at 20 miles or more the hour, or 200 the day for several days without refilling.
(v) It can move across country, and consequently free itself from the dominion of roads and railways.

The predominant limitation of the aeroplane is its fight against the pull of gravity; the tank is, in my opinion, the product of this limitation. Being able to protect itself against gas it can force the aeroplane to use bullets, and, consequently, to fly low. Then the tank will reply with bullets and the aeroplane will armour itself against them. Then bullets will grow bigger and the aeroplane armour thicker, and as the tank on the ground is less affected by gravity than the aeroplane in the air, the tank will attack not so much its powers as its preponderating limitation, its weakness, and the aeroplane will be forced to fly high and rely on the bomb.

To bomb a battleship is an easy problem compared to bombing a tank. It is conceivable that 20 torpedo-carrying aeroplanes could sink a Dreadnought, or that an equal number of machines, equipped with chemical bombs, could put such a ship out of operation. In the case of the tank it must not be over-looked that the offensive value of a weapon is correlated to its cost. Thus a modern Dreadnought costs £8,000,000, and a torpedo-carrying aeroplane about £5,000, consequently, the cost of one Dreadnought equals the cost of 1,600 torpedo-carrying aeroplanes. To risk, therefore, 20 or even 200 of these machines in the destruction of one Dreadnought is an economical operation. Not only is a tank a much smaller target to hit, but its cost should not exceed £10,000, or the cost of two torpedo-carrying aeroplanes. Would two be sufficient for its destruction, seeing that a tank can so completely cover itself with smoke that the two aeroplanes would have to descend within a few feet of the ground in order to aim their bombs, and whilst diving into the smoke, to nose for their prey, would be met by an upward spray of large calibre bullets or possibly small calibre gas shells, which would penetrate an inch of armour at 500 to 1,000 feet range? If two aeroplanes be insufficient, the addition of others at once renders the attack uneconomical; that is to say, if it costs more to destroy a tank by aeroplanes than the tank is worth, for equal sums of money more tanks than aeroplanes can be built, consequently, with the increase in the production of tanks is decreased the net value of aeroplanes as a means of destroying them. Finally, it may be asserted that one aeroplane dropping a shower of medium-sized bombs will be sufficient to destroy the tank. This assertion has, however, no foundation in past experience. In the recent war no single tank was ever hit by an aeroplane bomb. But, say you aeroplane bombing was still in its infancy. I agree but must add that so was the tank. As a matter of fact, in 1918, the aeroplane was 15 years old and the tank only two. For one aeroplane carrying, let us suppose, 20 anti-tank bombs, to hit a tank moving at 20 if not 30 miles the hour under a pall of smoke, would appear to me to be almost as difficult as to attempt, in a London fog, to hit a snipe with buck shot.

Whilst battles are raging in the air, battles which may be won in hours or days in place of months or years, on land must an army not only seek out its enemy but must race towards his vitals—his aerodromes, dockyards, chemical factories, workshops, and seats of government. Undoubtedly will the enemy attempt to protect these. If his shield is not hacked to pieces, what shall we see? Whilst the axe is being wielded against it, aircraft, like arrows, will speed over it; and fast-moving tanks, like javelins, will sweep past its flanks, and these will transfix the civil brains of the enemy with terror. Which side will outlast the other? this has always been the vital question in war.

In the recent war, had the Germans won the battle of the Marne, the war might have been over in six weeks, and be it well remembered, the German muscle-moving armies took four weeks to cover the 150 miles which separate Liége from the outskirts of Paris. To-day, an aeroplane can cover this distance in an hour, and, in a few years to come, a tank will be able to accomplish this journey in one day. Bearing in mind such rapidity of movement, it becomes almost a certainty that, in the next great war, the endurance of civil *moral* will be in inverse ratio to the speed of the war machines used; consequently, the duration of wars will be short, and, as I will now show, the power which can command the seas is the power which will hold the winning card.

The aim of a fleet is to gain or maintain command of the sea for the purposes of trade and the movement of armies. Before the introduction of the submarine, complete command was difficult enough, but since its introduction it is no longer possible; consequently, the question which should now be perplexing naval minds is not that of battleships *versus* submarines, but rather what constitutes the intrinsic values of these two types of vessels in the maintenance of command of the sea against all prospective enemies?

It must first of all be realized that the submarine vessel has introduced a third dimensional movement into the art of naval warfare. A submarine possesses the power to enter her " dugout " at most points on the surface of the sea. The main characteristic of the submarine is, in fact, her power to evade a fight and not her power to seek combat on equal terms with surface craft.

The object of a fleet, as I have already stated, is to maintain command of the sea in order to enable both traders and soldiers to move freely across the waters. As submarines can, however, move under the surface, consequently the commanding surface fleet can be avoided, which means that trade can still be protected by surface craft, since on the surface, surface craft are superior in fighting power to submarines. To carry out, however, the military purpose, as long as a traditional army is maintained, would demand such an enormous number of submarines that it becomes impracticable by this type of vessel. Should, however, the nature of such an army be so changed, that a powerful force could be moved by submarines under the water, it would then be possible to gain command of the sea, not by destroying the enemy's fleet or by blockading it, but by avoiding it, and attacking the will of the hostile nation upon which the stability of the fleet is based. In fact, what is contemplated here is, in place of hopping over an army by using aeroplanes, to dive under a fleet by means of submarines. In both cases the objective is the same, namely, the will of the hostile nation. If this can be accomplished, then the submarine will become the most potent of naval weapons, surface craft simply being maintained to protect merchantmen from submarine attack. This will mean that the big capital ship will eventually go out of commission and be replaced by a smaller and more mobile vessel.

There are two ways of attacking a ship physically; the first, when she is at sea, and the second when she is in harbour. It is not impossible to suppose that a submarine could be built which would carry six floatable tanks, and that a squadron of these submarines, supported by submarine monitors and gas projecting vessels, might appear off an enemy's coast line or harbour at the most unexpected moments and seize the point in question.

This example of a physical attack delivered by tanks transported by submarines against a military, or naval, objective must only be regarded as a stepping-stone to a moral attack on the nerves of the hostile nation. As the embarkation can take place at night, the initiation of the operation will be secret. As the machines will mainly be transported under the water, their voyage will be secret. As their destination will alone be known to the invader their landing will be secret. From its floating mechanical base will be launched a floating army. This force will propel itself ashore, crawl up the beach and move straight inland at a speed varying from 10 to 20 miles the hour. Within 24 hours of landing it will be 200 miles within the enemy's country. Freed from railways, and, I will suppose, possessing one week's radius of action, it will be able to terrorise the enemy's people, and if threatened by superior force it will generally be able to make for the coast, possibly several hundred miles away from its original point of landing and swim out to the submarines and re-embark.

Several such expeditions would cause inextricable confusion in the enemy's country, under cover of which a decisive attack might be launched against its main brain centre.

The whole of such an operation depends on sea power, not so much on the surface as beneath it. If we meditate for a moment on the possibilities of such an attack, rendered practical by wedding tank to submarine, two facts will strike us; these are:

(i) The secrecy and celerity of the operation.
(ii) The vulnerability of the civil target.

If to these two weapons we add the aeroplane, vulnerability becomes enormously enhanced. Consequently we may well ask ourselves, as Fontenoy courtesies are out of date, will not formal declarations of war follow suit. Bearing in mind that the main tactical problem in war is to hit without being hit, is it common sense to expect a nation, reduced to fight for its life, a nation which possibly possesses scientific weapons of tremendous power, and the power to develop surprise in its most positive form—an unexpected and terrific blow, moral or physical according to the theory of warfare held—to imperil victory by an open declaration of hostilities? Surprise in its positive form—an unexpected attack, possesses yet another virtue: it enables bloodshed to be reduced to a minimum, in fact, it enables policy to be enforced without killing or the destruction of property—it is the true sword of victory. I therefore predict that, when nations comprehend the real purpose of war, wars will not be declared, and that, consequently, small mobile striking forces will be kept ready, like fire engines, to extinguish at the shortest possible notice any conflagration which may break out.

To conclude: We start with wars of muscle, conflicts based on brute force, and of these conflicts we find that axe-warfare, the hand-to-hand fight, is the most brutal. We then find that gunpowder humanises warfare, as it enables long-range fighting to take place; nevertheless it, in its day, is anathematised, but eventually it wins through. Lastly, we find that gas can incapacitate without killing, it humanises bullet warfare, yet it also is anathematised, and it also will win through. Combining gas with the aeroplane, the tank and the submarine, all highly scientific means of movement, we find that not only can war be humanised, but that its traditional direction can be changed. In place of striking at the will of a nation through the body of its army, this will can be struck at directly, consequently, when this probability is brought home to civilised nations, wars are likely to become less frequent, and victory is likely more and more to depend on surprise.

Finally, before we sink back into our pre-war complacency, it should be remembered that nothing devised by human brains is perfect, there is ever a recoil, there is always room for improvement, and that that side which gains supremacy in invention and design is the side which is going to win the next war. In the past wars have frequently been decided by man-power, in the future they will almost certainly be decided by machine-power begotten by brain-power—possibly in a single test tube may be discovered the secret of the conquest of the world!

CHAPTER IX.

THE PROBLEMS OF AIR WARFARE.(1)

From the last chapter it will be realised what an important part air power is likely to play in future war. Improvement in aviation or the discovery of a new source of energy, may quite possibly result in drastic military and naval changes. These possibilities, however desirable, should not delude us into seeing things in a false light. To-day the limitations of aircraft are pronounced, all practically impinge on gravity. In this chapter these limitations are examined with a view to bring into focus the relationship between air power and naval and military power. To-day, the last mentioned is the only one which has not been placed on a mechanical footing. When it is, its influence on air power is likely to be very great.

Introduction.

WHEN compared to past wars, the most remarkable characteristic of the recent war in Europe was the rapidity of change in weapon power, means of protection, and means of movement. Though on land, and largely so at sea, the war was in nature static, in the air movement never ceased, and the development of air-power was so prodigious that towards the close of the war it bid fair to become the deciding factor. To-day there can be no question as to the general utility of air-power in war, and because of this, much loose thinking has taken place. The question which now faces us is not whether aircraft will be used with armies and fleets, or independently, but how they should be used at the greatest profit, for no nation is likely to possess sufficient to fulfil all needs on the outbreak of war.

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(1) *The Journal of the Royal Artillery,* October, 1927.

Confusion of thought on this subject may be traced to three main sources. First, armies and navies are tied to traditional methods of war, and so strong were these traditions that immediately the war was over, armies and navies, in place of reorganising from the position they had reached in 1918, stepped back to 1914 as their model. For soldiers and sailors the past possessed stronger attractive power than the future. Secondly, air forces having no pre-war past worth speaking of, and no traditions other than those established during the war, of which the most recent were the most vivid, could look squarely at the future, and in doing so were apt to overlook present possibilities. Thirdly, the future use of air power in war will depend very largely on the development of civil aviation. If this development is rapid, its own evolution is likely to keep pace, but if slow, then its growth will most certainly be restricted. It is the lack of equation between these three factors which has made not only the problems of air-power difficult to solve, but which has rendered their discussion somewhat unbalanced.

The problems I intend to examine may be divided into six groups, namely: (1) Internal Security, (2) Fortress Defence, (3) Small War Operations, (4) Attack on the Civil Will, (5) Attack on Fleets, (6) Attack on Armies. From so formidable a list it will be seen how vast is the range of air action, and how important it is to arrive at definite conclusions as to the group, or groups, more suitable for air operations.

1. *The Powers and Limitations of Aircraft.*

Before examining these groups of problems, I will turn to the powers and limitations of aircraft, for in these are to be sought the foundations of all argument.

The power which differentiates an air force from either a fleet or an army, is that of third dimensional movement. Aircraft are in no way restricted by terrestrial obstacles as a fleet at sea or an army on land; further, they can avoid fleets and armies, or attack them from above, that is, from a direction which cannot be met by advanced, rear, or flank guards. It is this power of being able to penetrate the normal system of defence, and strike directly at the centre of the older forces, in place of breaking through their circumferences, which constitutes so great a tactical revolution.

When attacked by aircraft, a fleet, or an army, is always in a defile, but one of a peculiar nature, since it is unscaleable, yet it offers no protection to the attacker. Such a defile may be compared to a valley flanked by immaterial mountains which at times can close in on the attacked and so place him in a gorge. To scale these heights at once introduces the air battle, which in one important respect is very different from an engagement on land or sea. On land the ground itself offers protection, and at sea armour can be carried, but in the air no direct protection can be gained, consequently the principle of security is only maintained through weapon-power, position, formation and surprise.

Tactically, air battles are simpler than those on land and sea, and though this simplicity facilitates organisation and training, it does not necessarily accelerate evolution, since, generally speaking, the complex permits of greater combinations. The fact that ground and sea do afford protection, and the air none, must inevitably compel the human brain to seek in them a counteraction to the high offensive power of aircraft, and by degrees limit this power.

I will now turn to the base of all tactical action—the ground. Administratively an army is more favoured by the vehicle it moves on than either a fleet or an air force, since the ground is not only its tactical but administrative area. A ship can remain only at sea for a few weeks, and an aeroplane can but remain in the air for a few hours. Their battlefields are not their administrative areas; this lack of coincidence constitutes a radical difference betwen them and the soldier.

From this brief examination may be deduced the following: The power of aircraft rests on their being able to avoid terrestrial obstacles, to attack armies and fleets from above, and to move at great speed for a limited space of time. Their limitations are governed by their inability to protect themselves directly against missiles, to remain at rest in the air (except in the case of airships), and to avoid frequent return to earth to refit and rest.

From these powers and limitations may be deduced that the aeroplane closely resembles a humanly regulated and directed projectile, a kind of animated rocket, fired, not from a trough, or a gun, but from an aerodrome, a "weapon" far more static than the heaviest piece of siege artillery, and one which, in existing circumstances, cannot be moved from place to place, for it is as immobile as a fortress. Whether air power will ever be able to replace land or sea power largely depends on overcoming this limitation, which means that, at present, tactical power and perfection are in importance secondary to facility of landing and supply. If it were feasible to devise a portable landing ground the size of a tennis lawn, and roll it up and unroll it horizontally on any normal ground surface, a far greater step towards the abolition of armies and fleets would be accomplished than can possibly be attained by all the tactical experiments now being carried out. In brief, the future of air power is not to be sought in the air but on the ground, for the ground is the bed and the belly of the aeroplane.

2. *Internal Security.*

Internal security may be examined under two general headings, namely, the maintenance of law and order and the suppression of rebellion. Neither are true military operations, and in both the object is to accomplish the end in view with the minimum of bloodshed. The police do not kill, and in this country they are not equipped for killing; but, in order to strengthen their authority, the soldier, who is equipped to kill, stands behind them, and he should only be called upon to support the police when such a threat becomes necessary. If killing has to be resorted to, then it should be remembered that the soldier does not kill rioters or rebels in order to punish them, but in order to persuade them to obey the police. If killing be looked upon as the end in view in place of as a means towards the re-establishment of police control, then killing must inevitably lead to innocent people as well as the guilty being injured, which is contrary to our ideal of law and order. British justice is based on the simple principle, that a man is considered innocent until he is proved guilty. To prove guilt demands trial, and trial cannot be replaced by shooting, which, consequently should only be resorted to when bringing people to trial, that is, arrest by the police, has proved itself to be impossible.

In civilised countries no one would dream of suggesting that air-power could, with advantage, replace military power as the physical base of police-power, since its killing-power is less controllable. In uncivilised countries it is obvious that police-power is far more restricted, since lack of communications render arrest frequently impossible, and necessitate a military expedition. In Iraq an experiment has been made to overcome lack of communications by air-power—if some local sheik rebels, an aeroplane is sent out to bomb his oasis or village, and terror may accomplish his submission without bloodshed. Should he refuse, however, to submit, he and his are bombed and the innocent suffer with the guilty. Is this British justice? It certainly is not. The difficulty being not only that the aeroplane is too powerful a killer, but that it cannot effect arrest—an aeroplane is in fact nothing more than a flying gallows, the epilogue and not the prologue of British justice.

The ultimate solution to this and similar police-problems is civilisation. Barbarous countries must be opened up by road and railways, for when these are built arrest becomes easy. Meanwhile what should be done? The aeroplane can nip a rebellion in the bud, but it cannot arrest, and the bomb cannot differentiate between innocent and guilty. Frequently the soldier, or the armed policeman, cannot get to the rebellious sheik in time, and when he does get to him the whole country may be in flames, and many people may have to be killed before the guilty are arrested. The problem is arrest in the least possible time. The aeroplane saves time, therefore one point is gained. The next difficulty to overcome is excessive weapon-power. In place of blowing up sheiks, goats, camels, women and children, why not gas them? To give them acute toothache, or colic, or to send them to sleep, is surely more humane than bombing or shooting them. Once they are incapacitated the airman should look for a landing ground, plane down to earth, pack up the sheik and go home. What the Air Force require to-day in their internal security problems is imagination and not bombs; they want a flying anæsthetist followed by a winged Black Maria.

3. *Fortress Defence.*

As the outbreak of war must of necessity find our forces somewhat scattered, our first problem is always one of fortress defence, both inland and coastal. Even a rising of tribesmen on the North West Frontier of India at first necessitates the holding of strategical and tactical forts, towers, defended camps, etc. Without a powerful system of fortified naval bases our sea-power may lose all its value.

In war, economy of force prohibits any attempt to be strong everywhere, and security demands that certain vital points are in immediate readiness to develop offensive power, and the more vital they are the more likely are they to be surprised. Consequently the main problem of strategy is one of equating concentration of mobile offensive power and distribution of static protective power. The second is the base of action of the first, and the more it can resist attack the greater will be the freedom of action of the mobile forces. In the case of a coastal fortress, it should be able to resist attack until the mobile forces can come to its assistance, or are at liberty to do so. Frequently it will not be possible to come to its immediate assistance without unhinging the plan in action, therefore, its offensive and protective capacity must be of a powerful order.

It is known from past history that a strong fortress is more than a match for an attacking fleet, but as its most powerful guns have a range of about twenty miles, and as a torpedo-carrying aeroplane can fly at least a hundred and fifty, it has been suggested that the aeroplane is a better offensive fortress-weapon than the gun. To tie up so mobile an arm in a fortress is manifestly unsound; further, to equip a fortress with an arm which can be readily removed, must encourage its commander to exaggerate every danger so that he may not be left in a helpless condition. But are fortresses really necessary, could not they be replaced by landing grounds, aircraft being concentrated at some central position? The answer to this question depends on time, the time taken to fly from the central position to the point threatened; further, it depends upon the ownership of the intervening territory, for it must be remembered that flight over neutral countries in war-time is a hostile act. The German raids on Hartlepool, Scarborough and Margate succeeded in spite of large forces of aircraft in this country, since time was insufficient for them to concentrate. If this was the case when aircraft were within easy reach, how much more so is it likely to be the case when distances run into hundreds of miles.

Mostly
training
aircraft.

It may be urged that this problem is not one of the abolition of fortresses, but of the substitution of the heavier guns by aircraft. A moment's consideration will show that this answer is as unsatisfactory as the last, since until the aeroplanes arrive the enemy can bombard the fortress with impunity. In war, the *moral* of the garrison of such a fortress would be low, for the fortress itself would be no more than a few acres of intermittent hysteria, its own defences would terrify it. Every rumour of a raid would influence its commander's nerves, and at the slightest alarm he would call for assistance.

A more important point now arises. Even if strongly attacked, it may not be strategically sound to assist him, and if he cannot hold out his surrender may be equally detrimental. As long as he can hold out, freedom of movement of the mobile forces may be assured, therefore there can be no doubt that whether aircraft can assist him or not, he will be better placed if his guns are equal to his enemy's.

The conclusion is, that because to-day ships at sea can be attacked by aerial torpedoes and bombs as well as by shells, the principles underlying the aim and purposes of coastal fortresses have not changed. Their object is not so much to prevent an enemy from occupying a position until assistance can arrive, as to relieve the Government from anxiety, so that attention may be focussed on the main strategical problem of every war, namely, concentration of mobile offensive power against the enemy's mobile forces; for once these forces are smashed his static protective power is reduced to dust. It was the victory of Jena which gave Napoleon all the fortresses between the Danube and the Baltic, and it was Waterloo which gave to the Allies all the fortresses of France.

The principles of security and offensive action have not changed since then, in fact, the high mobility of aircraft carries with it the danger that, because aeroplanes can move rapidly from place to place, and can avoid terrestrial obstacles, they will constantly be called upon to assist weak points. In fact, their concentration at any one decisive point will always be problematical, unless the vital points, inland or coastal, are more strongly protected than they have been in the past, or are to-day.

4. *Small War Operations.*

As the possibility of a small war always confronts us, I will deal with this question next: Is the aeroplane a more effective weapon in these operations than the soldier? To answer this question, the first point to settle is the object in a small war. It is frontier defence or conquest, and to-day it is entirely the first. We have frontiers in the Sudan and in India, both are more or less unget-at-able by soldiers, but easily approached by aircraft. The difficulty in all such operations is not the enemy but the nature of the country. On the ground the enemy is twice as mobile as the soldier, he has no military organisation that we can attack; few, if any, political centres we can strike at, and he is generally well armed. By the use of air-power we can move many times faster than he can, we can always get behind and above him, and none of these advantages can the soldier hope to rival. But there are two points in which an airman is at a greater disadvantage than the soldier: the first is that from the air it is more difficult to see a brown man with a brown rifle behind a brown rock, and the second is that it is more difficult to hit him. To fight small parties of tribesmen on hill tops with aeroplanes appears to me to be about as sensible as hunting fleas with terriers. The airman recognises this, for he says: "I am not going to hunt brown men behind brown rocks. I can move anywhere, I shall fly to the brown man's village and blow it off the map." In other words, the brown man has defeated him, so he flits away and bombs the brown woman.

This may or may not have the desired effect, namely, the surrender of the brown man, but it would be indeed strange if it had the ultimate effect of rendering our frontiers peaceful areas. What we really want are civilised neighbours and not savages. We want people we can trade with and who are of use to us, and not disgruntled or even cowed brigands. In the past the British Empire was pushed out from the sea coasts of these islands until it stands where it is to-day. Had we in the past based our frontier defence policy on obliteration in place of pacification, or

T.N.T. in place of trade, the Empire to-day would be a wilderness.

Should we then discard the aeroplane in our small wars? Obviously not, since its mobility and range of action cannot be equalled by the enemy. Nevertheless this must not blind us to the fact that in this primitive form of war, the more primitive form of attack, that by the soldier, is the one which is the more suited to the attainment of our object. It is true that gas would assist air power in these operations, but we are forbidden to use it, and further could hardly urge in excuse that the enemy used it first. Even if used, in mountainous countries, such as the North West Frontier of India, the aeroplane can seldom descend to earth, and unless the winged Black Maria can follow the flying anæsthetist, the fruits of victory, though shaken from the tree of war, cannot be gathered.

5. *Attack on the Civil Will.*

I will now turn to wars of the first magnitude, which in existing conditions are likely to embrace many nations, since during the last hundred years the civilised world has economically become more and more centralised. In such wars the object is definitely gain in one form or another. In the last great war our main object was to free ourselves from the threat of German naval supremacy; its cost was prodigious, and it ended in a disruption of Europe which to-day has spread to Asia. The main reason for its cost was the length of time it took to break down the will of the German people, which was only accomplished when German military power was shattered, and an economic blockade of the Central Powers established. If only the civil will could have been directly attacked, the length of the war might have been greatly shortened.

During the war two systems of direct attack were attempted, the one by propaganda, the other by air bombardment. Out of both of these systems of attack has grown a new conception of war, at least new since the days of Napoleon, namely, that wars can be more economically waged by terror than by destruction.

The air warfare enthusiast logically considers that since armies and navies can be avoided by aircraft, the civil will they are protecting can be directly attacked and so terrorised that the hostile government will either be overthrown or compelled to sue for peace. Further, it is pointed out with justice, that the aerial attacks carried out during the war frequently paralysed whole districts, and if in the next war these can be made more intense, the result must inevitably lead to collapse. If this argument is correct, then there can be little doubt that this form of war is likely to prove far more economical and far less destructive than existing forms. This conception of war is so revolutionary that other difficulties besides avoiding the enemy's armies and fleets and the bombing of his air force must be considered.

The attack on the civil will at once suggests that this problem must first be examined from its civil side, since if armies and fleets cannot protect the civil will, civilians will certainly seek other means of protection.

If the world were divided between two nations, there would be no neutral opinion in war, and belligerents could do as they liked, since the victor could arrange the peace following the war as he liked. Wars, it must be remembered, are means to an end, the end being peace, consequently this end largely influences their nature. In peace time, that is when all nations are neutral, is it rational to suppose that civilians will examine this new form of attack dispassionately? Is it commonsense to suppose that they will say: "The declaration of war depends on our will, so also does its duration. We recognise that if our will is broken the war will end; consequently, we full-heartedly agree that the most economical way of breaking it is to bomb us whilst in bed"?

It is not rational to make such an assumption, for it is far more rational to suppose that this supremely logical possibility will encourage every civilian to accentuate the barbarism of such an attack and restrict it by International law. If on the declaration of war, nation A bombs the cities of nation B, all neutral powers will morally range themselves against A, and will place A under the interdict of public opinion. This will place the moral support of all neutral powers at the disposal of B, a tremendous asset, for be it remembered that the winning over of world opinion by the Allied Powers during the Great War ruined the German cause morally. It may be said: "Damn morality, win the war, and then we can moralise." This may sound common-sense to the fighting man, but rightly and logically no politician would agree to this point of view, because he is not merely engaged in destroying the enemy's will, but in enforcing a policy, the success of which will depend on public and world opinion once peace has been re-established. To win a war is not sufficient, it must be won with reference to the following peace.

Assuming, however, that such a form of war is decided on, then air attacks on capital and other cities must be powerful and continuous, and as casualties are likely to be heavy, and as neutral powers may support the attacked, the attacker must be supremely powerful in the air. In such operations it is no longer a question of a one-power but a many power standard, and a large reserve to make good casualties. This introduces the problem of civil aviation.

Without civil aviation there can be no extensive production of machines immediately after the outbreak of war, and to-day civil aviation is in its infancy, and quite possibly will remain in a subsidised condition until a radical improvement in aero-engines takes place. We may dream of flying taxi-cabs and aerial tramp steamers, that is, of passenger aeroplanes and cargo airships, moving in all directions through the air. Though such dreams are not irrational, they are, in my opinion, unrealisable as long as petrol and the internal combustion engine are used, for the cost per ton-mile is so vastly greater than the cost on sea and land as gravely to restrict this traffic.

From this fact alone the general deduction is that no nation in the near future will be in a position to place all, or the majority of its war eggs in the air basket. The problem is an economic one as well as a moral one, and bearing these two factors in mind, it appears unlikely that at the beginning of a war any nation will embark on extensive air attack against its enemy's civil population. This must not, however, lead us to assume that later on in the war such attacks will not take place. Once war is declared, irrespective of civil resources, demand will eventually create a supply of machines, and, as the war continues, not only will neutral countries be swept into the vortex, but such as remain outside will, by degrees, grow sick of the turmoil; for though at first it may increase their wealth, as destruction runs its course so will prices rise and cancel out this profit. The mere fact that air-power may be able to terminate a war, will set each side searching for some, or any, excuse to use it to the full. Each side will accuse the other of infringing International agreements, with the result that sooner or later the bombing of cities will take place.

The question now arises: When strategically is it the correct moment to attack the civil will? The answer is: When supply will enable not only command of the air being gained, but will render possible a prolonged concentration of attack on definite centres. Again, there is another factor which must be considered, namely, the moral one. The attack should be launched either immediately after the enemy has suffered a disaster on land or sea, or when some great effort on his part has failed, or when an economic blockade of his ports or frontiers is beginning to be felt. It will be seen, therefore, that the correct time to launch the air attack is closely related to events on land and sea. In fact, once land and sea power have been able to restrict the movements of the enemy (tactical or economic) on land and sea, then air-power should take up the mobile operations of the war and direct its attack against the civil will. Not with the idea of destroying life and property, but with the aim of terrorising the people into abandoning the war so that their country may be occupied and their ships seized. In such attacks lethal and non-lethal gases and chemicals are likely to play a leading part.

6. *Attack on Fleets.*

Until the attack on the civil will is launched, the operations of aircraft will be restricted to attack on fleets, armies, fortresses and air forces. I will examine the first two only.

In an attack on a fleet, the factors which limit tactical air action are accentuated. Aircraft are so tied to their ground organisation that their radius of action is limited. A ship, even when aircraft are at so low an altitude as 3,000 feet, offers an exceedingly small target, and to approach it closer is dangerous, seeing that no direct protection can be gained in the air itself. Further, at sea, few aeroplanes can be carried on aircraft carriers, and the number of crashes on landing on their decks is likely to be considerable.

Since the war, bombing attacks against battleships have been disappointing, and under war conditions are likely to be more so. To take a naval example: Whilst in peace time gunnery practice shows about twenty-five per cent. of hits on the target, in war time the number of hits falls to about two and a half per cent. I see no reason to suppose that bombing results will prove more satisfactory.

To overcome the extreme difficulty of hitting small targets by bombs recourse has been made to aerial torpedoes. But with this weapon the factor of protection must not be overlooked, for to launch a torpedo an aeroplane has to approach close to a ship and descend to within a few feet of the surface of the sea. It has, in fact, to abandon one of the main advantages that third dimensional power endows it with, namely, protection by altitude, and approximate itself, as far as it is able, to a two-dimensional weapon, and so sacrifice this protection.

In spite of the fact that accuracy in bombing and torpedo attack will increase, I am of opinion that the limitations which gravity forces on existing types of aircraft will enable naval anti-aircraft defence to gain the upper hand. Whilst from the aeroplane accuracy of fire must, as far as can at present be seen, remain an essential, no such limiting factor controls the anti-aircraft fire from a ship. Here, to a very considerable extent, can volume of fire replace accuracy, a cloud of missiles replacing the single projectile.

In these endeavours to utilise old methods of attack, I am of opinion that the airman is blinding himself to his true powers. He is attempting to copy in place of originate. If, instead of attempting to prove that he, like a second David, can take on single-handed the Goliath of the sea, he were to consider a little more the problem of co-operation in his scheme of evolution, his immense utility would become manifest.

In one respect the submarine is the antithesis of the aeroplane, as she goes down whilst it goes up; yet both are three-dimensional weapons, the one finding protection in height and the other in depth. It appears to me that co-operation between these two will prove far more effective than the single-handed air attack. In my opinion, aircraft should take the fullest advantage of altitude, not only to protect themselves, but so that they can manœuvre rapidly above a hostile fleet. They should then not so much attempt to bomb their target as to disorganise its human element, by means of smoke, of a toxic nature preferred. Clouds should be placed on the surface of the sea so that they will either envelop the ship, or force her to tack in order to avoid them. They should be so placed that if she does tack she will do so to the advantage of the attacking submarines and destroyers. To compel a fleet constantly to change direction, and to obscure its signals, is to reduce its mobility and to disorganise its gun-fire and command. If the air attack can accomplish this disorganisation it will have fulfilled its task, and it can then hand over its victims to the light infantry of the sea.

7. *Attack on Armies.*

If the airman is on somewhat treacherous ground when dealing with sea attack, he is on far more certain when he claims to be able to annihilate armies and even replace them. He can move at 150 miles the hour, he can ignore armies altogether, and attack the civil will which sustains them, and if for political or International reasons, this form of attack is not advisable, he can either attack the troops themselves, or better still, their administrative organisation, the services in their rear. The truth is that armies as constituted to-day are so slow, so ponderous, so dependent on their communications, and so complicated, that on the line of march they undoubtedly offer excellent targets to air attack. Nevertheless, anti-aircraft defence is progressing, and the time may come when to attack an important railhead or supply centre will be as dangerous as a ship attacking a coastal fortress. The latitude of development, especially of protective means, is all on the side of the ground defences, since their evolution is little impeded by the force of gravity. Yet the difficulty of protecting all the vital points will be immense, and as long as armies are tied to roads and railways, and as long as their strength is mainly based on numbers, I am of opinion that the advantages of attack will rest with the air arm.

To the average soldier the solution of these difficulties appears obvious and simple. He agrees that an army, or its rear organisation, may be attacked almost at any moment, since the gaining of the command of the air is a far more difficult problem than its counterpart on land or sea. His solution is to use air-power to protect land-power, in fact, when it begins to rain, to open an umbrella over his head, an umbrella of aeroplanes. This solution is too obvious to prove tempting. He does not seek to reduce the vulnerability of armies to air attack, but instead to protect this vulnerability, to cancel it out by superior air power, so that he may continue to crawl over the earth's surface as his ancestors crawled before him.

This solution is not only fatuous, but destructive of military values; for if an army has to be convoyed into battle, surely it is better to scrap the convoy and release the escort. This is the airman's argument, and there is much in it if armies are going to remain as they are. But are they? Are they not beginning to wake up to the fact that their vulnerability to all forms of projectiles is not only a discount to them from the air point of view, but from the land point of view as well? Mechanisation is at last creeping to the fore, and what does it mean? It means a vastly increased mobility, a vastly increased protective power, power to dispense with roads and railways to a far larger extent than is possible to-day, and it also means reduction in size of target, since the military unit of measurement in the future will be efficiency and not numbers.

The influence of a mechanised army on an air force is likely to be great, for a mechanised army is not affected by gravity, it can move rapidly, not as rapidly as aircraft, but as rapidly as the aircraft ground organisation. This enhanced power of military movement will enable a mechanised army to attack the rear organisation of air power, and so to a large extent counter air attacks on its rear services.

We are yet too far distant to dogmatise, but bearing in mind that air power is more intimately tied to its ground organisation than an army to its rear services, it would not, so I think, be very hazardous to prophesy that in another great war the tortoise will beat the hare. Even to-day a fleet of armoured cars could move from Liége to Paris in one day, and could not be prevented doing so by air action. It is true that an aeroplane can accomplish this journey in an hour, and can do serious damage when it arrives at Paris, but it cannot remain there and continue doing damage; further, that on its return home it may find its own aerodrome occupied by hostile cars or tanks.

It is this power of attacking the ground organisation rather than the weapon itself which, in my opinion, will constitute the main air defence of the armies of the future.

What then is the answer? Certainly not to scrap aircraft, but to free them from such attacks by supporting them with mechanised armies. It is a problem of co-operation between land and air. The air to-day has the lead, therefore the land must follow suit. Aircraft, in my opinion, are not going to abolish armies, but in place they will compel them to mechanise.

8. *Conclusions.*

In conclusion, it seems to me that the facts of the case are as follows: Since the war the Navy and the Army have been glancing over their shoulders; they have a past, they have traditions good and bad which anchor them to it, they have roots which go back into the centuries, and these cannot easily be broken. The Royal Air Force has none, or so few that its whole mental outlook is different. It can look into the future squarely and without prejudice, it can look into it with high expectation and hope, for in the fact that it controls the third dimension, which includes the second, is hidden such tremendous power that no speculations can be termed impossible.

Those who control the Air Force, and who think clearly, must know well the existing limitations of their arm, and as they possess little or no past, they, by circumstances, are compelled to be prophets, and because of the prejudices and interests of the older Services they are forced to exaggerate their powers. Some are apt to be carried away by their own exaggerations, but most, so I think, are apt to be misled into making faulty claims because they accept the older Services at their own valuations. But they will change, and it is with the changed arms that they will have to deal.

The main limitation of air power is the force of gravity, and the first step towards overcoming its restrictions is to be sought in improved landing and in improved ground organisation. If to-day an aeroplane could take off from any ground and land on any ground, though gravity would remain as it is, its indirect influence on aircraft would be vastly reduced. The whole of this problem is one of mobility, and the next, namely, the direct protection of aircraft from ground and sea attack, is closely related to it, and, in my opinion, is unlikely to be solved until a new source of energy is tapped. The third problem, namely, offensive power, is largely wrapped up in the question of gas warfare. If chemical warfare is to remain taboo, then the offensive power of aircraft will be limited to the destruction of life and property. It is of vital importance to air power and to humanity that non-lethal gases should be used, and how to use them is a far more important factor than how to sink battleships.

Besides these three great problems, or series of problems, we find the more purely operational ones, namely, internal security, small wars and great wars. In examining these, three categories of factors must never be overlooked. These are politics, based on public opinion; strategy, based on the principles of war, and tactics—the fitting of these principles to local conditions. It is no good planning an ideal war which the politician will not fight, and it is no good imagining that a good turn is being done to air power if it is allotted a multiplicity of duties. If this is attempted, concentration of force will be impossible, and without concentration of force scientific warfare is impossible. Further, it should be remembered that tactically the whole aspect of war is changing; area warfare is gradually replacing linear warfare, and more and more is the rear of a navy, an army, or an air force, becoming the decisive point of attack. It is this very point which is so vulnerable to air power, for it is here that the vital organs of a fighting service are situated. Finally, the Air Force should remember that it is the thunderbolt of future war, therefore its strength should not be dispersed simply because it can carry out a certain task or operation. Is it *the* task in which its full powers can be developed? for when it is called upon to strike there must be no delay, no waiting for the collection of scattered units. It must strike with the utmost speed, the utmost secrecy, and the utmost strength; for speed, secrecy and strength are the surest foundation of the knock-out blow.

CHAPTER X.

TACTICS AND MECHANISATION.[1]

Having examined the relationship between mechanised land forces and air power, certain concrete problems will be reviewed, but before doing so it is necessary to devise a system which will enable the student to analyse the various factors and possibilities which will confront him. To-day, we are thinking in terms of an army mainly propelled by muscular power; the army of to-morrow, propelled by petrol and oil, will possess a far more powerful motive force, consequently, its organisation will have to be changed. What are the fundamental tactical factors in both organisations? If these can be discovered, then the process of evolution from the old to the new will be greatly facilitated. The object of this chapter is to discover these factors.

1. *The Primary Tactical Function.*

IN war the object of a commander is to accomplish victory at the smallest possible cost and loss, and the means whereby he attains his objective in the field is by developing mobility through protected offensive power. He strives to attain freedom of movement and action through combining a variety of arms and weapons in such a manner that fighting power is expended economically, by which I mean the obtaining of full value for losses sustained and for energy and material used up.

It is obvious that changes in civil life must intimately affect the life of an army. It is equally obvious that changes in science, industry and engineering intimately affect the nature of weapons,

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(1) *The Fighting Forces,* April, 1927.

and as long as these civil changes continue we must expect coincidental changes in weapons, and the means of movement and protection we employ. As weapons change so must tactics, the art of fighting, change, and as this art changes, so must organisation and training change, just as they do in civil engineering and industry. Yet whatever these changes may be, our primary tactical function remains the development of mobility through protected offensive power; all other tactical functions are subsidiary to this one, because, in fact, it embraces them all.

2. *The Obsession of Offensive Power.*

From the close of the Napoleonic Wars—that is, when steam power began to forge ahead and remodel civil life—right up to the outbreak of the Great War, we find a vast and never-ending improvement in weapons, that is, in offensive power; but we find no comparable improvement in means of protection, that is, other than through weapons themselves. Further, means of tactical movement remain unchanged—namely, muscular, human or animal.

Before the outbreak of the war this unceasing improvement in weapon-power threw tactical ideas out of focus. It was considered that mobility could be developed through offensive power alone, and that offensive power—that is, hitting—would provide its own protection. The primary tactical function was then shorn of one of its essential elements, and the result was that tactics became deformed. Immediately the war began, human nature, the primary function of which is to cling to life and shun death, immediately readjusted the balance by suggesting the trench to the soldier, so that the protective element might be reintroduced.

In the circumstances it was the only thing that could be done. Nevertheless, though offensive power was now protected, no mobility worth talking about could be developed from it. Gas, as a means of asphyxiating life in a whole area, was rapidly countered, and even the most powerful artillery bombardments resulted only in limited penetrations, and the formation of battle salients in which the attackers suffered more heavily than the defenders who held their outer perimeters. By these means the war could only be ended through attrition; tactics had ceased to be an art, they had degenerated into mathematical calculations of bullets and shells.

3. *The Influence of Petrol.*

In the history of war, if it is not so to-day, it will one day be realized that the introduction of petrol-power marks a change as all-embracing as the introduction of gunpowder. Gunpowder changed the form of war, but it did not change its primary tactical function. Before fire-arms were used, battles were mainly assaults; after they were adopted they became attacks culminating in assaults. Armies advanced by roads, then deployed, frequently within view of each other; then they attacked over two or three hundred paces of ground, and finally delivered an assault. In both cases mobility was developed from protected offensive power.

By the beginning of the present century, the range and accuracy as well as the volume of fire of weapons had increased to such an extent that the assault became the exception and not the rule. This was well recognised after the Franco-Prussian and Russo-Japanese Wars, with the result that tacticians saw that frontal attacks had become unprofitable, therefore they advocated enveloping attacks instead.

In the Great War fire-power was largely increased by the general adoption of the machine-gun, and such vast numbers of soldiers were deployed that more frequently than not fronts became continuous, and, until they were broken, enveloping attacks were rendered impossible. The question of how to break the enemy's front had, therefore, to be answered before mobility could be regained. It is here that petrol-power came to our assistance.

4. *The Influence of the Tank.*

The influence of petrol-power on the war was so stupendous that it has not even to-day been fully appreciated. It changed the whole form of war, and it will continue to change it as surely as it has and is changing the form of civil life. Last year there were 22,000,000 motor cars in the United States alone, that is, one to every five inhabitants. In this fact can be read to a very large extent the future of armies.

Without perol-power the great artillery battles would have been impossible, since the millions of shells fired could not have been carried forward from the rail-heads. Without petrol power the aerial bombardments of London, Paris, and other cities would have been impossible; and without it armoured car and tank attacks would have been unknown. It is with this last-mentioned weapon which I will now deal.

Strictly speaking, the tank is not a weapon; it is an armoured cross-country vehicle which carries weapons; it is, in fact, only a mobile machine-gun, or gun mounting, just as a ship is. It was introduced and used during the war as an assault weapon, and since infantry fire could not aid or stop its advance, when it was used the assault preceded the attack. Strictly speaking, the infantry attack ceased to be an attack, and became a follow-up or slow pursuit.

The weapon which assisted, or resisted, the tank was the field gun. As the war proceeded it became more and more obvious that, on ground over which tanks could move, infantry, either to assist or resist a tank attack, were useless. Infantry, who since the introduction of gunpowder had become the queen of the battlefield, were relegated to the position they held during the Middles Ages.

They could still fight in woods, swamps and amongst hills, but their reign over the plains was at an end. This, in my opinon, is the supreme tactical lesson of the war: petrol-power enabled armour to be re-introduced, and armour enabled offensive-power to be protected; thus it enabled the primary tactical function to be re-introduced. It re-established tactics as an art.

5. *The Problem of Mechanisation.*

An art can only be appreciated by people possessing some knowledge of it, or by those born with an artistic temperament. In 1919 military artists were sadly lacking, and the result of this was that, in place of taking the above lesson to heart, all great armies went back to their 1914 military organisation, plus an extensive increase in small-arm fire-power. It was not the bullet which was the decisive factor in 1918, it was armour, and since, in all civilised armies to-day, bullet-power is about three times as great as it was in 1914, we are in a worse tactical position than we were thirteen years ago. As far as I can see, the only solution to this problem is mechanisation.

What is our object in mechanisation? It is to endow the army with a higher energy than it possesses to-day; it is to replace and supplement muscle-power by mechanical-power. The problem which faces us is identical with that which faced industry on the advent of steam-power. We have got to replace muscle-work by machine-work, and the energy latent in oil and petrol enables us to do so.

This energy enables us to attain a vastly higher degree of mobility. It enables us to carry more powerful weapons, and to supply them with greater quantities of ammunition, and it enables us to protect ourselves with armour. By means of petrol we can become artists of war; without it we can only remain foot-sloggers, bullet-sloggers and bullet-slogged. It appears to me that there is no choice but that we must mechanise, and I will now inquire into how we should proceed.

6. *Thinking in Functions.*

First and foremost we must get the present form of war out of our heads. What is this form? Battles waged by cavalry, infantry and artillery. We must forget these arms, and no longer be chloroformed by their names or organisations. We must cease to think in names, and must learn to think in the terms of tactical functions. This is the first step towards rational, in contra-distinction to chaotic, mechanisation. For example, a carpenter has a bag of tools, but he does not think of them in terms of hammers, pliers, saws, etc., but in those of the functions of these tools. He thinks in terms of boring holes, sawing planks, hammering in nails, etc. He uses his tools according to their powers. If you were to ask him which is his decisive tool, he would think you were mad, for each is superior to the other when properly used.

The functions of a carpenter are to bore, cut, hammer, pull and stick, and he possesses a variety of tools in order to carry them out. If anyone invents a new type of tool which enables him to carry out the function required more economically than with those he possesses, should he have the money to buy it, he buys it, because his wages depend on his work; he does not get his back up and fight the new tool tooth and nail. Yet this is what the soldier does with every new weapon invented; frequently he looks upon an invention as a personal insult.

In my opinion, if efficiency and economy are our aim, the soldier must cease to think in names, and learn how to think in tactical functions, because functions remain the same, and names very frequently change. Thus, an archer, an arbalister, an arquebusier, a musketeer, and a rifleman are all names for men equipped with various weapons which possess the same tactical function—namely, to discharge a missile from a portable piece of artillery: the bow, the crossbow, the match-lock, the flint-lock, and the rifle. Weapons change in form, and their names change accordingly: while functions remain constant in nature, but vary in degree. If we will persist in thinking out tactical problems in terms of cavalry, artillery and infantry, then we shall render our minds rigid to all new ideas. To persuade our minds to become flexible and recipient we must think in functions.

What, then, are these functions? To answer this question all we need do is to think out our main requirements in battle.

First we have got to find our enemy and simultaneously prevent him from finding us. Once we have found him we must hold him—that is, we must attempt to restrict his mobility. Thirdly, we want to hit him, and, simultaneously, fourthly, we want to protect ourselves from his blows. Once we have exhausted him, fifthly, we want to smash him to pieces.

Here are five tactical functions—namely, to discover, to hold, to hit, to protect, and to smash. In the past discovery fell to the lot of light cavalry and light infantry; holding to light infantry and infantry of the line, lightly protected by field artillery; hitting, to infantry of the line, supported by all manner of artillery; and smashing to heavy and light cavalry.

To-day we are faced by a host of new arms. Our aim as soldiers is to win a battle economically, or defend a position economically. Of these new arms the most important are—aeroplanes, tanks, armoured cars, dragon artillery, self-propelled artillery, anti-aircraft guns, machine-guns, and light automatics. Do not let us be petrified by their names; let us examine their powers and limitations, and then from these deduce their functions. Next we must compare their degrees of power with those of the older arms, and, when we have made our comparison, without prejudice we must decide which arm possesses the highest degree of power.

7. *The Influence of Ground.*

In working out these comparisons, the deciding factor is ground, which possesses three tactical qualities—it aids or restricts mobility, offensive power and protection. Administratively, ground may be divided up into roaded and unroaded country, and tactically into plain land, undulating country, hills, mountains, forest areas and swamps.

Of the newer arms I mentioned above, all, save the machine-gun and the light automatic, are moved by petrol, and, with the exception of the aeroplane, the rest are moved, or will in the near future be moved, on tracked, half-tracked or multi-wheel carriages—that is, they will be able to move across country. Of these machines, I will examine the tank as an example.

Of all existing arms, the modern tank possesses the highest freedom of movement over plain land and undulating country, but swamps and thick forests may completely stop it, and in hilly mountainous regions its mobility may be restricted to a small number of easy approaches. On ground it can negotiate it has nothing whatever to fear from infantry as to-day equipped; it has little to fear from any projectile-throwing weapon with inferior mobility to itself. Even in 1918, on the Western Front, where no flanks could be found and where guns could never be avoided, no well and strongly mounted tank attack failed to smash the German lines, and in 1918 tanks were slow-moving machines. To equip infantry with an anti-tank weapon is of some use, but if this weapon is to be really effective it must be able to move as fast as a tank; yet as it has to protect infantry, it cannot move far from them. Tied to slow-moving infantry such weapons may be compared to destroyers escorting a convoy at sea—their tactical radius of action is extremely limited.

I do not wish to labour this question, for to me the answer is self-evident—namely, that on country suitable to tanks, the tank can hold and hit more economically than infantry can, and by holding I do not mean sitting on a position, but taking up a position which will prevent an enemy from moving from the one he is sitting on. For example, it is not necessary to enter a man's house to hold him in it; all that is necessary is to cover the front and back doors by riflemen from outside.

As regards discovering, that is reconnaissance, I have frequently heard it said that the tank is unsuitable, since it is a blind machine. I admit that the Vickers tank may not be the must suitable type of reconnaissance machine, but that it is of necessity blind is sheer nonsense. An infantryman in a trench is normally blind, but in a tank on reconnaissance duty there is no reason why its commander should not stand with his head and shoulders completely outside his machine.

For smashing purposes, tanks are obviously more suitable than cavalry, since they are impervious to bullets, and for protective work, though they can largely protect themselves, there can be little doubt that they should be supported by artillery. As this artillery cannot be horse-drawn, it must consist of either dragon-hauled guns or self-propelled ones. Of these two, the second are obviously the more suitable.

We arrive, therefore, at this conclusion: that on open and undulating country, mechanised arms will carry out the tactical functions far more economically and effectively than the older ones, because they are able to develop a higher mobility on account of their superior protected offensive power, which is the primary tactical function itself. As to this, there can be no doubt in my mind, for it is a matter of common-sense.

In wars against civilised nations, plain land and undulating country is undoubtedly more important strategically and tactically than mountains. In a war of the first magnitude, I know of no decisive battle which has been won or lost in a mountainous area. Nevertheless we must be prepared to fight in these areas, for many subsidiary operations will take place in them. It is obvious that, though tanks and similar weapons can assist in these localities, the arm which can most effectively move in them is infantry supported by mountain artillery.

Thus, by testing the tactical values of the mobility, offensive and protective powers of arms and weapons by the various categories of ground met with in war, we arrive at an answer of no little value—namely, that in the future we must divide each battlefield into two main tactical areas —areas suited to the movement of mechanised arms, and areas not so suited. Then, whenever possible, if we distribute our arms accordingly, shall we attain the most economical results. For brevity's sake, I will call these two areas Tank Areas and Infantry Areas.

8. *Changes in Organisation.*

If this deduction is accepted—and I fail to see how it can be refuted—the next problem in mechanisation is to organise an army so that it can maintain the primary tactical function in both the above areas.

In the tank areas we want four, if not five, main types of machines. To give them old names, we want light cavalry, light infantry, infantry, artillery and heavy cavalry; or, to call them after their tactical functions, a reconnaissance tank, a holding tank, a hitting tank, a protecting tank, and a smashing tank. The first class should consist of armoured cars, multi-wheeled and possibly also half-tracked, and light one-man or two-men tanks; the second, a class of machine somewhat similar to the present Vickers tank; the third, to the new heavy tank; the fourth should consist of self-propelled guns; and the fifth of extremely fast machines, of which no model as yet exists.

In my opinion the third and fourth classes will eventually coincide. Then we shall get four main classes, which, according to their tactical functions, may be compared to destroyers, light cruisers, battleships and battle-cruisers.

In the infantry areas the tactics and organisation of the older arms will have to be radically changed, for whilst in the past it was the exception for these arms to fight in mountainous country, and the rule to fight over plain land and undulating ground, these will now be reversed. In these areas we require a true light infantry, light cavalry, and light artillery. We require a very flexible and mobile organisation, very intelligent and lightly-equipped men, and a few heavy guns.

The infantry of the future have a far more difficult task to carry out than they had in the past, yet it is a far more interesting task, and a task which will require so highly trained a soldier that few, if any, conscript armies will be able to provide him. Reconnaissance will be the duty of the light cavalry: holding, of light cavalry and riflemen; hitting, of riflemen and light automatic gunners; protection, of machine-gunners and mountain artillery; and smashing, of light cavalry, riflemen and cavalry machine-gunners. It will be seen, therefore, that the changes in organisation will be considerable. Not only does the future demand different types of soldiers for different operations of war, in which there is nothing new, but an organisation which will include two categories of soldiers, each of which moves at a different pace. The nearest simile to this in history is to be found during the seventeenth century, when sieges were more frequent than field battles. Then the field army of the day was followed by a slow-moving siege train.

The siege train of the future is the non-mechanised arms, arms which storm mountains and forests in place of fortresses and castles. The field army is the mechanised force.

9. *Summary.*

I will now briefly summarise what I have written. The probabilities are that in the future petrol-power will revolutionise the art of war as extensively as did the introduction of fire-arms. Whatever this revolution may be, the object of battle will remain the attainment of economical victory through mobile, protected offensive power. This power is developed by means of weapons, the use of which should be governed by their respective powers and limitations.

The older arms are all directly limited by muscular-power; the newer break away from this limitation, since petrol enables a higher mobility, offensive power and protective power to be attained. Petrol, consequently, must change the present form of war. How will it change it? The answer to this question demands clear thinking.

To think clearly we must cease thinking in names of weapons and arms, for if we do so we mentally shackle ourselves. In place we must think in tactical functions, and abandon any idea of the discovery of a universally decisive arm, for such an arm is as mythical as the universal solvent of the alchemists. Each arm is superior to any other arm when conditions permit of it developing greater effect.

The tactical functions are finding, holding, hitting, protecting and smashing, and the side which can develop the higher mobility will obviously have time in its favour.

Which weapon will in any set of conditions prove the superior weapon depends very largely on the nature of the ground. Ground may be divided into two areas, tank areas and infantry areas, from which two main categories of tactics can be developed—namely, plain warfare and mountain warfare. Finally, history is a great mental laxative; it frees our minds from shibboleths, and, happily, it has a habit of repeating itself. In the Middle Ages the knight in his armour ruled the plains, and the staunchest infantry came from Switzerland, Scotland and Wales. Yet there was nothing new in this, for in the days of Joshua the Canaanites with their chariots of iron were masters of the valleys, while the children of Joseph held fast in Mount Ephraim.

CHAPTER XI.

PROBLEMS OF MECHANICAL WARFARE.(1)

"Big Mars seems bankrupt in their beggar'd hosts,
And faintly through a rusty beaver peeps:
The horsemen sit like fixed candlesticks,
With torch-staves in their hand . . ."
King Henry the Fifth, iv. II. 43.

"O! now doth Death line his dead chaps with steel;
The swords of soldiers are his teeth, his fangs;
And now he feasts, mousing the flesh of men."
King John, ii. I. 351.

Military problems may be catalogued under three main headings—great wars, small wars, and internal security. Armies are raised for two purposes, namely, to maintain law and order within a country, and to protect it from invasion, or to invade a foreign land. The armies of 1914 could effectively carry out the first of these objects, but as regards the second, lack of mobility in small war operation, and lack of offensive power in great became pronounced shortly after war was declared. In this chapter these problems are examined, not with the intention of elaborating the detail of possible changes, but to arrive at a few broad ideas of the difference in value between existing armies and mechanised ones in great wars, small wars, and internal security.

Introduction.

The final victory of the Allies in November, 1918, was so stupendous an event that it is apt to obscure from us the main issue of over four years of war, which was not the defeat of the Central Powers, but the destruction of the world outlook—social, political and military, as it was accepted by all civilised nations before the outbreak of the war. So all embracing was this cataclysm that, during the years immediately following the cessation of hostilities, no other condition was possible save that of a world-wide revolution, the intensity of which can better be gauged from the changes which have taken place in ideas than from the quantity of blood spilt. These changes are still gaining power, and, in the vortex which is sucking down old institutions and belching up new ones, the military forces must take their place.

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(1) *The Army Quarterly*, January, 1922.

In August, 1914, the tactical mobility of our Army was based on muscle; the infantry marched, the cavalry rode, the guns were dragged by horses, and, except for a few lorries and a few aeroplanes, our soldiers were scarcely more mobile than their ancestors at Waterloo. In this respect our Army did not differ from the foreign armies it fought with or against. Nevertheless, the war which followed was different from all preceding wars, in that the railway, the great civil means of movement, was at once turned to strategical account. This enabled such an inundation of soldiery to be effected that warfare has never seen its like before. So pronounced was the influence of the railway that, failing a navigable river, or proximity to the sea, no great army could subsist without locomotives to supply it. Where railways were many, fronts became continuous, as in France and Flanders; where few, broken, as in Russia; and where only one railway existed, unless one or both flanks rested on the sea, open warfare on the exposed flank, or flanks, became possible, as in Mesopotamia, Palestine, Sinai and Syria. In railless countries, operations were of the small war type.

On the Western Front, the first great lesson of the war was: that, when masses of men are engaged, a serious tactical failure is likely to result in a strategical deadlock; the second, that a strategical deadlock is likely to result in a war of attrition; the third, that a war of attrition is a war based on supply. Consequently we find that, before the war was six months old, because of, and not in spite of, the enormous facilities of movement rendered possible by the railway, all tactical movement ceased, until we see two immense phalanxes of men facing each other, as they did 2,500 years ago, but hurling projectiles at one another in place of pushing pikes. As in the days of Alexander, the longest pikes wielded by the staunchest side normally won, so was it hoped by multiplying weapons to defeat the enemy. Seemingly, however, it was not realized that just as every foot added to the *sarissa* reduced the mobility of the hoplite, so every shell exploded on the ground reduced the mobility of the foot soldier, the horse soldier, and the wheeled vehicle, whenever the breaking down of the enemy's resistance rendered an advance possible. Alexander, realizing his own particular difficulty, did not seek to overcome it by increasing the length of weapons, but by making extensive use of cavalry; consequently, most of his victories were gained by the cavalry charge. Since the days of Alexander, except for a break of some 800 years during the Middle Ages, when infantry disappeared before the armoured knight, this distribution of tactical power between infantry and cavalry remained the normal process of gaining battles down to the close of the Seven Years' War, after which a rapid decline in the opportunity of the cavalry charge took place, until, after the Franco-Prussian War, massed cavalry charges became impracticable. Turning now to the difficulty which confronted us in the Great War, we find that ultimately we solved our own particular problem by the old Macedonian tactics, but in a reverse order. The tanks charged the enemy, disorganised and demoralised him, and then only did the infantry advance and drive him from the field. In this reversal of the historic method of attack is to be discovered the germ of a great number of our future problems.

Why was this reversal necessary? It was necessary because modern fire-power, coupled with trenches protected by entanglements, rendered it impossible to advance, and until the infantry could advance the cavalry and gunners behind them had to remain stationary. The tanks carried out, therefore, the primary duty of the infantry, namely, the disorganisation of the enemy. The cavalry attempted to pursue, but, on the Western Front, consistently failed, as they could not face the machine-gun; the infantry attempted to pursue, but failed equally because of their lack of mobility; finally, the tanks attempted to pursue, but also failed because they did not possess the necessary radius of action or the requisite mobility to protect themselves against the enemy's gun-fire.

Had they possessed these attributes, pursuit, that is, the act of annihilating the enemy, would have been possible, especially if the artillery and supply vehicles could have kept up with the pursuing tanks in order to protect and supply them. Had such an operation been feasible, then the ancient method of waging war would not have been reversed, heavily amoured tanks would have broken the enemy's ranks, and lighter armoured and faster tanks would have destroyed the fractions thus created. Towards this ancient method of warfare we were returning when the Armistice terminated hostilities, for we were then building a large number of machines of two types—a five mile the hour machine and a ten mile the hour machine, with a possible twenty mile the hour machine should the war last late into 1919.

If, then, the ancient method of battle is sound, namely, that we should disorganise our enemy before we attempt to annihilate him, and, if these two acts can most efficiently be carried out by armoured cross-country machines, what part are infantry, cavalry, artillery and road supply vehicles going to play in future warfare? Here, then, are four military problems of the first magnitude, on the correct solution of which will depend the entire foundations of our future Army.

I propose to consider these problems in three categories—great wars, small wars, and internal security, the three purposes for which armies are raised.

1. *The Great War Tank Problem.*

Assuming that the reader is well acquainted with the lessons learned from the use of tanks during the late war, I will suppose that, at some future date, two armies meet in battle, and that each side possesses infantry, cavalry and artillery as equipped to-day, and two types of tanks—a light cavalry tank with a speed of 25 miles the hour, and a heavily armoured infantry tank with a speed of 15 miles the hour. What will then happen?

It may be assumed forthwith, if the lessons of the last war are of any value, and if human nature remains what it is, that, by the time the two armies are within striking distance, the infantry will be in rear of the infantry tanks and the artillery in rear of the infantry. Tank will consequently engage tank, and a battle for tank supremacy will result. As cavalry cannot take part in this battle, unless it be employed in galloping towards the hostile machines and scattering land mines in their path, an operation which might more efficiently be carried out by a mine-laying tank or by an aeroplane, the cavalry tanks will be detached from the arm they are protecting, and will manœuvre behind the infantry tanks ready to move forward should the enemy's tank front be pierced, or preparatory to attacking this front in flank.

The question now arises, what can the infantry do? These troops can do nothing outside playing the part of interested spectators. What can the gunners do? They can do next to nothing, for being distant from the actual field of action, upon which in a minute a tank may have changed its position by a quarter of a mile, they dare not promiscuously bombard any area; besides, in order to fire at all, they will generally have to employ direct laying which, in most cases, will necessitate them being either with, or in advance of, the infantry. In such positions, as the gunners, in order to protect themselves, cannot lie flat like the infantry, their pieces will soon be silenced by hostile machine-gun fire.

I will now carry the battle to its next stage. One side will gain tank supremacy and the shattered remains of the other side will retire. As the pursuit will be rapid—at from ten to twenty miles the hour—the defeated tanks can either retire with their infantry, which delaying them will jeopardise their retreat, or else abandon their infantry and let them be destroyed. Falling back on their artillery, what can the gunners do? They cannot move their guns without their horses, which are very vulnerable to fire, and they cannot fire them whilst in movement. They must, therefore, remain stationary, and, if the ground in front of the guns be an obstacle to tank movement, they may possibly hold up the enemy's infantry machines which, if they advance behind a smoke cloud, will be very difficult targets to hit. Meanwhile, the enemy's cavalry tanks will be racing round the artillery flanks in order to attack in rear the guns, wagon parks, teams and command headquarters. We see, therefore, that, even if the artillery can halt the hostile infantry machines, in nine cases out of ten the guns are likely to be destroyed in a few hours. The only arm which will be able to save itself from destruction is the cavalry, not by charging the enemy, but by galloping off the field.

In the main this picture is not overdrawn, because to-day tanks exist which can move at twenty-five miles an hour. True, they are not reliable—neither was the motor car in 1900, nor the aeroplane in 1908—yet the tank to-day is as old as these two means of movement were twenty-two and fourteen years ago, consequently there is no reason why reliability should not be accomplished within a few years of to-day.

The question now arises, what is the utility of cavalry, artillery and infantry as equipped at the present time? I will inquire into this question in some detail.

The cavalry charge, save against ill-equipped barbarians who frequently inhabit difficult cavalry country, is to all intents and purposes dead. Yet does not cavalry still possess utility for reconnaissance? Aeroplanes can see much more in general, but far less than the trooper can in particular. They cannot move through woods or examine houses, they are not suited for obtaining information from the inhabitants, and for tapping telegraph wires, neither can they lie concealed in country which offers facilities for hiding as, normally, this type of country is the very worst for landing. Why, however, cannot cavalry for purposes of reconnaissance be replaced by fast scout tanks, unarmoured or very lightly so over their vitals, each carrying two men armed with automatic rifles? There is no tactical reason which should render this impossible. The machine will be able to traverse all ground which can be crossed by a horse, except perhaps very thick woods and very narrow hill tracks, both of which can, however, be better negotiated on foot. Being small it can be hidden; it will require no horse holder; it will not require feeding and watering when standing still; it will be able to carry a week's rations for its crew and explosives for demolition work; further, it will be able to traverse distances of 100 miles and more in twelve hours. Frankly, there is nothing of intrinsic importance which cavalry can do now which a scout tank will not be able to do much better in the near future, except break in half, and so permit its crew of two men galloping away in different directions.

I will now turn to the artillery. The gun to-day is dragged by six horses; it cannot fire whilst in movement; for prolonged marches it requires a road, and, being fashioned for long-range action, it is not suited to carry out its own local defence; consequently, it must operate in rear of the infantry, or, if distant from the infantry, it must be provided with a special escort.

There are three ways in which guns can be motorised. They can be hauled by a cross-country tractor; they can be mounted with their wheels on a cross-country transporter, or fitted on to a tank. The first method is obviously a makeshift, with these advantages, however, over the existing equipment—namely, that more ammunition can be carried into action, and that the tractor, when free of the gun, can be used as an ammunition carrier. The second method is a great advance on the horse-drawn gun, for the gun can be fired from the transporter. The third, which possesses this advantage in a more accentuated form, also possesses the important characteristics of not needing an infantry shield in front of it, or a local escort to protect it; consequently, it can operate in advance of the infantry and take part in the tank *versus* tank battle. The advantage is so considerable that any difficulty in concealing the machine is fully compensated for; further, it is a very moot point whether static concealment from aircraft observation is anything like as effective a means of protection as ability to move rapidly from place to place.

I will now turn to the last of the battle arms—the infantry. First of all, it must be realized that, even though infantry may still be "The Queen of Battles," for 800 years during the Christian era dismounted troops were mere pawns in the game. When the armoured knight ruled the battlefield, infantry was employed merely to garrison castles, or to hold tactical points such as swamps, forests and hilltops, that is, localities in which the knights could not move. I believe that the armoured tank is going to create a tactical condition similar to that created in the past by these armoured horsemen, and that, in the near future, infantry will continue to exist, but only as the defenders of positions—rail-heads, bridge-heads, workshops and supply magazines. As this is a point which is likely to be hotly debated, I will trace the evolution of this assumption.

To provide the infantry with an escort of tanks is no guarantee that in battle, if the tank *versus* tank engagement is likely to fail, any but a totally incapable commander will not at once withdraw all these protective machines in order to support his tanks, for on their success will depend victory or defeat. Assuming that we shall have a capable commander, his initiative can of course be restricted by supplying him with protective tanks, the speed of which does not exceed the pace of the infantry; but to suggest such a restriction is absurd, for these slow machines would be no match against faster hostile ones, should they break through.

We must try another solution. The infantry may be equipped with a heavy machine-gun, which will weigh with its tripod at least ten times the weight of a rifle, and, therefore, an infantryman will not be able to carry it. It will have to be mounted on a transporter, and, as off this machine it will be immobile and on it unprotected, the first thing its crew will ask for is protection by armour. We are once again back to the tank and an indifferent one at that, for the effective range of the tank gun against a lightly armoured tank is far greater than that of a heavy machine-gun against a heavily armoured machine; in addition to this objection, there will be nothing to prevent the heavier tank adopting a heavy machine-gun as its in-fighting weapon.

As it would appear that the heavy machine-gun will not meet the purpose for which it was intended, it would be preferable to give to the infantry a high velocity gun such as the tank 6-pounder. If this were done, the evolution would be the same as in the case of the heavy machine-gun. Starting on its wheels, it would end in a small gun-tank, and if it were found to be an efficient tank destroyer, then its proper place would be in the tank battle and not behind it.

I consider that the main deduction to be made from the above conclusions is that whatever offensive weapon we may give to the infantry, it will have first to be motorised; secondly, armoured; and thirdly, taken away from the troops at all critical periods—periods when it is most required. We must, therefore, in my opinion, seek for a solution in a purely defensive weapon, that is to say, a weapon which cannot be used when in movement. Such a weapon is the land-mine, which, to hark back to mediæval warfare, will take the place of the old-fashioned moat. It may, therefore, be predicted that tank mine layers will accompany the future infantry, siege artillery and administrative services. In order to keep in the vicinity of the battle, though always at a safe distance from the actual front, the infantry and administrative troops will be carried forward in cross-country transporters, the descendants of the motor 'bus. These transporters will be lightly armoured and constructed so that they may be made gas-proof, and endowed with a sufficient speed to enable them to escape from their strongholds should the tank mine sweepers, which tank mine layers will render necessary, succeed in clearing a way through the mine-fields. Lastly, as warfare is likely to become more and more mobile in nature, the slow digging hand spade will be replaced by the cross-country trench-digger, so that, when halted, the infantry and their transporters will be able to seek cover by ground in order to protect themselves from aircraft attack.

From the above we may gather that the tank has not only come to stay, but also that it will revolutionise existing modes of warfare Cavalry is likely to disappear, except perhaps as mounted police; infantry may become the " Queen of future Fortresses," but the rule of this monarch on the battlefield is rapidly drawing to an end, for without offensive power this Queen is bereft of her crown. Artillery will become doubly important, and, as speed is added to this arm, the old naval struggle between gun and armour will find its counterpart on land. Then will the infantry tank, as we know it to-day, disappear and be replaced by the heavy-gunned and strongly armoured land battleship—the artillery of the future; then will the cavalry tank, relying on less armour but greater speed, become the battle cruiser. Numerous auxiliary machines may be built, but on these two types I believe that the battles of the next great war will be founded, battles which will be fought after the fashion of Alexander—the *hoplites* holding, and the *cataphracti* annihilating the enemy.

As to the supply services, even if the reader may dismiss the whole of the above as " such stuff as dreams are made on," he surely must agree, if he has learned anything at all from the recent war, that the following is one of its greatest lessons: namely, that *the chances of victory or defeat are multiplied directly by any increase or decrease of road-power in an area of operations, and that, unless this road-power is equal to the supply requirements of the attack, either the attackers must eventually die of starvation or the attack must be abandoned.*

Even with an army at the present time—a road-bound army—the cross-country supply transporter can reduce the length of the marching columns, can reduce the weight carried by the soldier, and can enable him when deployed to remain deployed and be provided with shelter, hot meals, cool drinks and the hundred and one requisites which differentiate civilised warfare from the combat of barbarians. How much more so will this be the case in the tank wars of the future?

2. *The Small War Tank Problem.*

However fascinating may be the study of the next great war, the subject is a highly speculative one, particularly so as the next war is in all probability a remote event, for great wars normally originate in a breaking down of the balance of power between nations, and, as to-day this balance no longer exists, it will have to be reconstructed before it can be rebroken. Before this balance can once again be established, much friction will take place between the broken and damaged nations which the last breaking up of the balance of power has produced, and, during this period of reconstruction, we may expect to witness a series of small wars arising out of the ferment of discontent which such friction inevitably produces. Our immediate problem is, consequently, not a great war but a small war problem, the nature of which is far less speculative, as small wars change slowly, and their nature is generally known.

We, as the inheritors of a world-wide empire, have an all but unlimited knowledge of the nature of small wars; we have engaged in them for over two hundred years, and throughout this long period our difficulties in winning them have been very similar.

I do not propose in this article to examine these difficulties in detail, for they should be familiar to every military student, but rather to venture the assertion that, in practically all the small wars in which the British Empire has been engaged, the outstanding difficulty has not been the tactical power of the enemy, but the physical characteristics of the country in which he lived. In order to grasp the validity of this assertion, I propose to divide small wars into their types, and to examine each type in the light of its history. These types are:

(i) Desert warfare.
(ii) Plain warfare.
(iii) Mountain warfare.
(iv) Bush warfare.
(v) River warfare.

To begin with, it must be realized that, in the small wars of the past, two fundamental difficulties have usually existed. The first is, that, in nature, small wars are like attacks of intermittent fever, they give little notice of their advent, prostrate a district rapidly, and are frequently highly contagious. The second is that of distance, the distance which separates the delirious district from the military forces which can quell the outbreak. To-day the British Army may be likened to a poor and overworked country doctor who, possessing no carriage or car, is compelled to walk from patient to patient in order to tend them as best he can, generally indifferently. On his feet he can manage to visit about twenty scattered patients in the course of a day, but in a motor car, he could visit forty, and therefore, should the time arrive when he can buy a motor car, he would be a complete and senseless fool if he did not do so, for with one he will be able to double his utility and his income.

Our present small war problem is almost identical with the problem of the above doctor. Law and order constitute the health of a nation, unrest is its disease; those who judge and govern us are the specialists, and we soldiers the general practitioners upon whose skill the social health ultimately depends. Sometimes we are called upon to perform a surgical operation, sometimes to administer an anæsthetic, sometimes a pill, even a bread pill, for frequently social disturbances can be as easily quelled by suggestion as bodily ones, for the origins of both, as often as not, are imaginary. Our difficulty is not one of skill but of distance, of time taken in our numerous and periodical visits, for, as the greater number of our patients are of barbarous predilections, they live in most inaccessible places. In order to visit a demented Arab, many hundreds of miles of desert may have to be crossed on foot or by camel, and to operate on some kleptomaniacal Pathan may necessitate months of most fatiguing hill climbing and coolie work as elementary in nature as in the days of Alexander and Tamerlane.

To-day, our lack of mobility in small wars[1] stands out a truly remarkable contrast against the present day enormous powers of civil means of movement —the locomotive, the lorry and the motor car. Why is this the case? Because small wars take place in undeveloped countries where railway construction is expensive as the countries are not sufficiently wealthy, or civilised, to render such construction commercially remunerative; where roads do not exist, and where their maintenance is most difficult. Some day railroads will be built, but only after the countries concerned are worthy of their building. What then are we to do? We must maintain law and order so that stability of government may foster prosperity and contentment. We can do this either by maintaining an army of a million men, costing several hundred million pounds a year, which to-day means conscription and bankruptcy, or we can drastically reduce the Army which we have and motorise the remainder. We may not be able to design tanks which will scale hilltops, but why should we attempt to scale hilltops if in an armoured box on tracks we can advance securely along the valleys, and when this progress is impossible, walking can always be resorted to, but it should not be contemplated as long as the machine can move. The doctor may on occasion have to leave his car at the garden gate, and walk from there to the front door of his patient's house; because of this his car is not rendered permanently useless. In mountain warfare our problem is identical.

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[1] A recent example of this is the Moplah rising. On the 19th of September, 1921, the following statement appeared in *The Times:* "The Troops were hampered by the mobility of the rebels and by the difficulties of transport and communication."

In desert warfare it is scarcely necessary to accentuate the tactical advantage accruing from the possession of a fast-moving tank, or of a water transporter carrying five tons of sterilized water, and, if necessary, an ice plant as well. One machine of this nature can carry sufficient water for 224 men or 112 horses. For such numbers 28 camels are theoretically required, but, on account of evaporation and jolting, in practice 40 are necessary. Forty camels require further camels in order to carry water for them; thus it happens that with a large force of men all the camels in the world would not get it across Arabia.

In warfare on the plains, and in thickly populated lands, what are the main difficulties? The guarding of communications, the escorting of convoys, and the likelihood of being shot at from every bush, paddy-field, go-down and house. The difficulties vanish, or at least grow small, before the armoured box on tracks, for it does not require to have its communications protected, it does not require an escort, it can run over a bush, or through a paddy-field, or over a go-down, and it can enter any village and demand capitulation.

In bush warfare the difficulties are greater, but they are not insurmountable, though the construction of a machine suitable for this type of fighting would probably be uneconomical seeing how seldom we are confronted with this problem. For river warfare, the possibilities of an amphibious tank require no accentuation.

Whatever may be the demands of future great wars, for present and future small wars motorisation is essential. Recently, a rising of the Senussi was quelled by a few armoured cars; during the South African war de Wet was never caught, but when, at the beginning of the last war, he again took to horse, he was run to ground by an armed motor car in a few weeks. If a wheeled vehicle can do this, a tracked vehicle can do several times as much, for it can indirectly reduce the size of our Empire by endowing the soldier with an increased power of movement. Aldershot is 30 miles from Hyde Park Corner; a trained athlete will walk this distance in 10 hours and be dead beat at the end of it; a soldier will take 30 hours and be equally exhausted; a Rolls-Royce car will take one hour and at the end of the journey its driver will be to all intents and purposes as fresh as when he started. What has the Rolls-Royce car done in terms of distance? It has reduced it by nine-tenths in the first case, and by twenty-nine-thirtieths in the second—this is our immediate small-war problem.

3. *The Internal Security Tank Problem.*

Internal security is closely related to the problem of small wars, but with this difference, that, whilst a small war is normally waged against an alien nation, internal security refers to the maintenance of law and order among subject races and peoples; consequently, as every British citizen has a right to live, even when temporarily demented, law and order should be enforced by as bloodless a process as is possible. To kill a man may destroy the ravages of disease, but it is no cure.

Here, again, we may illustrate our intention by returning to the doctor. We will suppose that he is called in to tend a patient suffering from *delirium tremens.* What does he do? He does not creep towards the bed and, when the maniac is not looking, hit him over the head with an axe; on the contrary, he tries to pacify him, and, if necessary, straps the sick man down so that he may not injure himself or others; in fact, he tackles the case on the spot and uses common sense.

To-day, we hear much of the possibilities of maintaining law and order by means of aeroplanes. Is this feasible? Before answering this question let us set ourselves another: Do human beings live in the air or on the earth? As they live on the earth it is plain that they must be controlled on the earth. But cannot men be controlled from the air? Certainly they can be so controlled, if we follow the example of the doctor and the axe. There is a truculent knave in Mosul; very well then, send fifty bombing machines there and blot that ancient city out, obliterate it like Carthage, man, woman and child! This method is so easy as to be impractical; we no longer live in the days of Nebuchadnezzar or Ghengis Khan; George V is our King, and, further, the British Empire has not been built upon obliteration, but on pacification.

Not for a moment do I deny or doubt the enormous and ever-increasing powers of aircraft. The Air Force may ultimately replace Navy and Army in great and small wars, but, in my opinion, it will never replace the policeman, and a policeman is what the soldier is when he stands behind the law of the land and says to all would-be delinquents—" Move on."

To-day the policeman-soldier is armed with weapons of war; I consider that, so far as it is possible, he should be equipped with weapons which neither kill nor permanently injure. Is any Imperial benefit gained by shooting down several thousand Hindus in Amritsa, or Moplahs in Madras? For the greater part of their lives these unfortunate victims were useful law-abiding citizens; for a few days, or weeks, they were demented maniacs. Is dementia, and particularly social dementia, cured with the axe? If not, how can it be cured? The answer is by non-lethal gas, and this answer is hazarded in spite of the archaic diatribe delivered by Professor Sir Edward Thorpe, President of the British Association of 1921, against gas warfare. What could be more effective than the progress of a tank through a riotous crowd, a tank which emitted a laughing gas, or a lachrymatory gas, or a sneezing gas, or a colic-producing gas, or a simple and harmless anæsthetic. A man cannot simultaneously orate and sneeze, and a colic-stricken rioter is a most indifferent looter, for he will have other things to do. People like Professor Thorpe are bloodthirsty monsters compared with the gentle behaviour of the operators of such a machine. Why do not we at once adopt so simple a solution to a real and existing difficulty? It is hard to say, unless it is that, like Professor Thorpe, we allow preconceived ideas to obliterate our imagination, which, when all is said and done, is an exceedingly useful faculty.

CHAPTER XII.

TANKS IN INDIA.(1)

In the last chapter the use of tanks in small wars was considered. To us this is one of our most important problems, seeing that the only land frontiers which we possess, save that of Canada, are bounded by semi-civilised nations. The most important of these frontiers is the North-West Frontier of India. If mechanised arms cannot operate in this possible theatre of war, the reorganisation of the army at Home will either be seriously delayed, or two armies will have to be maintained, one for European warfare and the other for Oriental. In this chapter the North-West Frontier is examined from the mechanised warfare point of view, and it is shown that no insuperable difficulties exist which prevent one type of army successfully waging war in Europe or Asia.

THE question whether the Army in India should be equipped with tanks is quite as important as whether these machines are of tactical use in that country. This, on first thought, may seem an anachronism, but on second it will be realized that unless the army at home and the army in India are similarly organised, equipped and trained, in place of one army there will be two, the tactical co-ordination of which is impossible. In England, the tendency of military thought is slowly but surely veering towards mechanisation. Whilst five years ago the tank enthusiast had to fight for his ideas, to-day he has the bulk of the junior officers on his side, and even amongst the senior he will frequently find full-hearted allies. In the West there is not a shadow of doubt that mechanisation will proceed steadily towards a complete re-organisation of European armies, and it is certain that the nation which leads in this change will be at a tremendous advantage over those who trail behind. It is also certain that whether the army at home wishes to mechanise or not, mechanisation will be forced upon it. No citizen, or politician, who thinks at all is going to tolerate another 1914-1918 war. The people, rightly, will refuse to have their sons, brothers and fathers slaughtered on wholesale lines, and though they may know little about the process of mechanisation, they know quite sufficient about the existing organisation to welcome even the wildest fanatic as long as he points to a less costly and less bloody war. If mechanisation is to be accepted by the army at home and not by the army in India, then the Cardwell system goes to the wall, and the only principle of co-ordination the army has ever had, namely, similarity of parts, vanishes in thin air. Further than this, it must be realized, and in India it is often overlooked, that the army in India, is as much an Imperial force as the army at home, and as the army at home may be called upon to fight in the East, so must the army in India, as was the case in 1914, be prepared to fight in the West, and unless it can fight in the West, that is, fight against industrial nations, it ceases to be an Imperial asset. For India to say: " This is not correct, we are but waiting until the home army shows its hand before we follow suit," is no answer to the above statement. It is no answer because by refusing to mechanise India is gravely impeding mechanisation at home.

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(1) *Journal of the United Service Institution of India,* October, 1927.

Only recently a brigade of mechanised guns had to revert to a horse establishment, because India is persuaded that the horse is more suitable than the dragon. Even if India is right, how can the home authorities press on with perfecting the new order, if no sooner a new unit is built up than it is smashed to pieces. India must realize this. If India does not, then, I repeat it again, the Cardwell system is doomed, and the future will see two armies and not one—a highly mechanised force at home, and an army of militia value in India.

Fortunately conditions are not as bad as they look. There is hope, for though the army in India is unequipped with tanks, anti-aircraft artillery, mechanised field guns, anti-gas appliances, and mechanised machine-guns, the armoured car has been accepted, and so has the 30-cwt. lorry, and so has the six-wheeled lorry which is likely to replace it. These are encouraging signs, yet the fact remains that it is almost as dangerous to talk of tanks in Delhi as to sing " God Save the King" in Moscow. It is not only a curious but a perplexing state of affairs, seeing that though certain experimental tanks sent to India in 1921 proved a failure, others sent there in 1926 (remembering what they were asked to do) proved an unqualified success. Where then lies the crux, for unless the stoppage in the pipe of Indian military thought is located, it will be utterly useless attempting to force new ideas through it.

In the autumn of 1926 I had the good fortune to visit India, and one of the several questions

I had to enquire into was the use of tanks in that country. No sooner had I landed than I was confronted by two factors of military importance, these I will call the hill-top outlook and the truncheon outlook. The mountain warfare expert could see nothing but inaccessible crags, and the soldier-policeman nothing but seething mobs of riotous natives which must be gently patted on the back. The first said: " Your tanks cannot climb these hills—they are useless." The second: " They must not shoot down these poor people—they are inhuman." As regards the second I am little concerned, for internal security is essentially police work, and if it is inhuman to shoot rioters from inside an armoured machine, I cannot see that it is any the less inhuman to shoot them down by infantry rifle fire. " But they are not shot," replies the soldier-constable, " They are moved on, they are pushed aside." Such action is pure police work, and if the army in India is to degenerate into a police force, then the sooner it is divorced from the army at home the better, the Cardwell system must then go.

As regards the first, the mountain warfare expert, I had to raise myself to his exalted level, for I soon discovered that until I could say: I have seen half the hill tops in Asia, I should be at a discount, and that any arguments I might venture upon would founder on inaccessible crags. I therefore visited the North West Frontier, and, in a month, saw more of it than many Indian Army Officers see throughout their service. My journey was as follows: Nowshera to the Malakand Pass, thence to Peshawar; Peshawar to Bara Fort and Lundi Khana; Peshawar *via* Kohat, Fort Lockhart, Gulistan, Shinawari to Thal; Thal to the foot of Piewar Kotal; Parachinar to Kohat; Kohat to Bannu; Bannu to Razmak; Razmak *via* Sarwakai to Jandola; Jandola to Dera Ismail Khan; Sibi to Quetta; Quetta to New Chaman; New Chaman *via* Pishin to Hindubagh; Hindubagh *via* Kila Saifulla to Loralai; Loralai to Harnai, and Loralai *via* Ziarat to Quetta—all by road. I insert this itinerary so that the reader may know what parts of the Frontier I visited, I do not do so to pose as an expert. Expert I am not, neither in mountain warfare nor tanks, nothing more than a student in both, consequently, when I left Delhi on October 31st for the Frontier, I determined to view the whole question of mechanical warfare in that area with an open mind.

The Frontier may, for practical purposes, be divided into two main zones, namely, the Northern and the Southern, the dividing line between which is the valley of the river Zhob. The Northern is extremely hilly, some of the mountains rising to well over 15,000 feet; the Southern is less so, but what is more important from the tactical point of view is that it is inhabited by tribes of a less martial nature. The Northern zone, it may be said without fear of contradiction, is, with few exceptions, unsuited for mechanised warfare on wholesale lines, but should the construction of roads continue, this condition may possibly change.

Roads mean commerce, trade leads to prosperity, and should such wild countries as Tirah and Waziristan become prosperous, it will follow that the tribesmen will live more and more in the main valleys, where, if necessary, they can be struck at by tanks and armoured cars. Such operations are, however, unlikely, for once these wild people gain prosperity, they will cease to be warlike. This possibility does not, however, exclude the fact than an invasion of India in the North must proceed *via* the Kabul river or the Kurram, that is, down the two main valleys and not over the mountains by goat tracks and by paths. Accepting conditions as they are to-day, I will now enquire into the use of tanks and similar machines in both these zones.

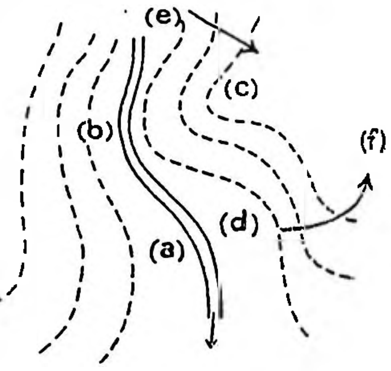
The Northern Zone is split up by the valleys of the Kabul, Kurram, Tochi and Gomal rivers and their tributaries; to these may be added the Swat and Kunar, the second of which I did not see. In many places these valleys are of considerable width, and though the rivers flowing through them are apt to form many shifting channels, most of these are normally dry, and though in many places strewn with shingle and boulders, generally speaking, they could be negotiated by tracked, or even six-wheeled machines. In the Kurram valley there is nothing worth mentioning which would stop a Vickers tank, and in what I saw of the Jalalabad plain, the same applies, though the going, on account of the nullahs is nothing like so good. As far as my opinion goes, seeing that heavily laden

Dodge and other motor cars run daily from Lundi Khana to Kabul, there is no reason why in war time, a small well-equipped mechanised force should not fight its way, if needs be, from Lundi Khana to Jalalabad in about 12 hours. And from what I have been able to gather of the condition of the road westwards from this town, I see no reason why, once the passes leading into Kabul are picketed, such a force should not be able to move from Jalalabad to Kabul in about twice the above time. It should here be remembered that the picketing of the hills for a mechanised force will be far less arduous than for an infantry column, seeing that to a large extent the danger of the bullet is excluded, and that generally speaking the points to be picketed will be only the rest camps and heights so close to the road that, should it be blocked, rifle fire can be brought to bear on the obstruction.

In frontier warfare, as it faces us to-day, there are two important tactical operations in which the tank would prove of great value, namely, the attack on a valley village, and the attack on a Tangi, or nullah-gorge. In the first operation there are two difficulties, the village may be surrounded by sodden rice fields separated by mud banks some two feet in height, or it may, and will almost certainly, be protected by towers. I examined the fields carefully, and came to the conclusion, though I was unable to prove it by experiment, that a sodden rice field would be a formidable obstacle to all existing types of wheeled machines. First, the wheels would cut into the soft surface of the soil, mostly mud, and secondly, even if the front wheels surmounted the boundary banks, many back axles would be broken. If, however, the field has about a foot of growth on it, I am of opinion that a light tank would cross it fairly easily, for the tracks would, in place of cutting through the rice stalks, beat them down into a mat which would go a long way to support the machine. Whether without this mat a tank would cross these fields when flooded, I doubt.

In an attack on mud towers, many of which are of great thickness and little damaged by field artillery shells, I suggest three courses of action: (1) That the tank haul behind it one or more oil drums (large steel casks) filled with high explosive, and trail these up to the tower in question, unhitch them close to it, set in action a time fuze, and then retire. There is nothing fanciful in this. for though such explosive casks were never used during the Great Uar, they were experimented with. The idea then was to trail 10 or 12 of them through a village occupied by enemy infantry. Each cask was equipped with a time fuze which could be set at a varying number of minutes. The cask could be released and the fuze set in action from inside the tank, consequently no man had to get out of the machine. (2) Use the tank as a smoke-producing machine, and when the tower is enveloped in smoke, destroy it in the normal way, or occupy the village and besiege its garrisons. Gas or lachrymatory chemicals would obviously be more humane, but they are forbidden by the humanitarians. (3) Move the tanks up to the tower and fire shells through the loop-holes.

In mountain warfare, the main line of approach is normally along a nullah, in any case the supply columns have to use nullahs or tracks, consequently the tribesmen will gather at points where nullah or track runs through a gorge. For infantry, the forcing of a Tangi is a particularly difficult and dangerous operation. The tribesmen occupy one or both sides of the gorge, a frontal attack is costly, consequently an out-flanking movement has to be resorted to, for it is common knowledge, once the tribesmen become aware that their rear is threatened they retire. I saw many of these Tangis both in the Northern and Southern Zones, and was convinced that in attacking them tanks would prove of the greatest value. The one I will now examine in order to illustrate the tactics I suggest is the Ahnai Tangi on the Takki Zam river, which was attacked by our troops in 1919, and where we sustained heavy casualties.



The sketch is purely diagrammatic as I have no large scale plan of this particular gorge. The Takki Zam is shewn by the letters (*a*)-(*e*). The Tangi is at (*b*), and the Mahsuds were at (*c*). The British Commander, so I was informed, could not force the Tangi, so he delivered an attack from (*d*) towards (*c*), his men being shot down in large numbers. In place of such an operation, I suggest that a section of light tanks could easily have moved up the Takki Zam from (*a*) to (*e*), and at (*e*), have peppered the ridge (*c*) and so taken the enemy in reverse. Had this happened, and had the British Commander moved towards (*f*), and from (*d*) have held the enemy by fire, he, in my opinion, would have suffered very few casualties, and the enemy would either have been annihilated or have withdrawn. If I saw one such position as the Ahnai Tangi, I must have seen a hundred, nearly every nullah contains them. I do not suggest that in such operations as these the tank is normally going to slaughter the enemy, but I am certain that if tanks are used most of the difficulties of Tangi fighting will disappear, and that nullah advances will consequently be greatly speeded up.

Turning now to the Southern Zone; mechanised warfare in this area approximates more closely to its counterpart in Europe. In this zone, though there are passes such as between Harnai and Loralai, which are as difficult as any in the North, generally speaking, the country is more open, the most likely theatre of war, that between Chaman and Kandahar, consisting very largely of plain land. I saw no insuperable difficulties for tank operations down the Zhob valley, anyhow as far east as Kila Saifulla, and though the ground between Hindubagh and Bostan is more broken, tanks could operate over a good deal of it, as they could also along the Loralai river to Ziarat. South of Quetta I saw nothing of the country except the Bolan Pass, but operations in the neighbourhood of Kalat are unlikely. Immediately west of Quetta, though the country is cut up by hills, water courses and nullahs, once the Kojak Pass is crossed, what appeared to me to be ideal tank country is entered. Looking westwards from the top of this pass towards Kandahar, and knowing that motor cars daily travel to and fro from this city to Chaman, I see no reason why a mechanised force should not, in the war conditions to be expected, move from New Chaman to Kandahar in a day. If this can be done, then the whole strategy of the Southern Zone is changed, for Kandahar virtually is in our hands, and from Kandahar we can strike towards Farah and Kabul, both of which cities can to-day be reached from Kandahar by motor car.

My journey at an end, the general conclusion arrived at was that to-day, and more so in the future, tanks are a necessity for the defence of the Frontier, and for operations beyond it. I have no patience with the critic who will, and he certainly will, attempt to founder this conclusion on quicksands, precipitous crags, rivers in spate, kareses and boulders. All these things and many others are annoyances, but they are not insuperable difficulties. To examine so important and really vast a problem as the one under review, the fly-brained cannot help us. Our outlook must be broad as was that of Browning's "Grammarian":

"That low man goes on adding one to one,
His hundred's soon hit:
This high man, aiming at a million,
Misses an unit."

"Units" I refuse to discuss, for I am convinced, after having seen some 1,500 miles of the North West Frontier, that unless India accepts the tank and kindred machines her army must become obsolete. Thirty years ago it was difficult enough to beat the tribesman, badly armed as he was. To-day, as practically every fighting man in the Northern Zone is in possession of a modern rifle, and, if a war comes, may well be provided with machine-guns by the Afghans or Russians, my considered opinion is that the British Army in India must either be modernised or be prepared for a casualty list which will shock the foundations of our rule in that country. The problem, to my mind, is not should India accept mechanised weapons, but what types of mechanised weapons are suited to her war requirements. This problem I will now examine.

The General Staff in India, rightly, so I hold, consider that the Vickers tank and the present artillery dragon are unsuited to Frontier warfare. What are the conditions? Few railways, few roads, vast distances of approach, light bridges, intense heat and cold, sand and shingle, iron-hard ground, and a country which is agricultural and non-industrial. As an example of what all these things mean, I will suppose that a battalion of Vickers tanks is to be moved in the hot weather from Jacobabad to New Chaman, and that the railway cannot be used. First it will have to cross an almost roadless track from Jacobabad to Sibi, then it will strike a good road, and after crossing two high passes—the Bolan and the Kojak—will arrive at its destination. On paper it will do so, but in fact, I am convinced, it will not do so. I do not believe that with the existing tank half a dozen machines out of 50 would ever reach New Chaman; further still, most of the tanks left on the road would not be repaired for months, and the sick list would be high.

Though in my opinion the above is no exaggeration, and though it condems the present type of tank, and the present type of dragon, it does not condemn all types, and the problem is, consequently, one of discovering a suitable type.

What are the requirements? It must be able to travel long distances; it must demand few repairs; it must not exhaust its crew, and, if possible, it should be very light and cheap.

The machine which at once suggests itself is the light tank, or tankette, a machine which costs about £700 and weighs something under a ton. Here lightness and cheapness (essential in India) are obtained. Now as to the other requirements, which may be bracketed under one heading, namely, endurance. I cannot see even an improved light tank travelling from Jacobabad to New Chaman, but we know that in all probability a six-wheeled lorry would cover this journey with ease. Therefore, I suggest that the light tank be mounted on a six-wheeled lorry; this done, it will arrive at its destination absolutely fresh. What is required in India is not a land battleship but a mechanical mounted infantryman.

The lorry will require a driver and his mate; the light tank will require a crew of two men. I suggest three such crews, one to fight the tank and two in reserve. The whole of this outfit—lorry, tank and 8 men—will form the smallest tactical unit; and all the men will be carried in the lorry as well as their equipment and supplies.

The advantages of such an unit are:

(*a*) The personnel is sufficient to move, maintain and fight the tank, and the spare crews can be used for local protection when at rest.

(*b*) The tank on the lorry can be used as an armoured car, in which case the engine and the driver should be armoured.

(*c*) The tank is saved wear and tear in all purely logistical movements, its repair bill will be small.

(*d*) The total weight of about 6 tons can be divided when weak bridges have to be crossed.

(*e*) The crews travel in comparative comfort, and can replace the lorry driver when he is tired.

(*f*) When tanks are not required, or are lost, the six-wheeled lorry can be used for purposes of supply; and when tanks are in action to move infantry across country.

(*g*) When bad ground is met with, the tank can assist its mechanical horse over it.

It looks very much as if we had solved the problem, so I will now turn to organisation.

I suggest, as a basis of discussion, that a company of these light tanks should replace one infantry company in every British battalion, and that this company should be organised as follows: Three fighting sections of 7 tanks each, one being the section commander's machine. A headquarters section of 4 tanks, one for the company commander, and three for purposes of inter-communication. Besides the 25 six-wheeled lorries required to move these tanks should be added the following: 1 for baggage, 1 for cooking and rations, 2 for water, 1 fitted as a mobile workshop, 3 for spare parts, petrol, etc., and 2 for ammunition. The total company will then consist of 25 tanks, 35 six-wheeled lorries, and about 200 officers and men. The cost of 25 tanks and 35 lorries at, say, £700 a piece, will be £42,000. The cost of 25 Vickers tanks would be nearly five times this figure.

To turn now to tactical requirements and weapon power; uniformity is important, therefore I suggest that the field gun, anyhow for India, should not be hauled by a dragon but by a six-wheeler. It may seem that this suggestion contravenes the principle of co-ordination through similarity of parts. To a certain extent it does, for if the field guns of the home army are hauled by dragons and those of the army in India by six-wheelers, a difference is established, but one nothing like so great as that which exists between a dragon-drawn and a horse-drawn gun. As in the Royal Tank Corps a driver is taught to drive a tank or an armoured car, I see no reason why the drivers of dragon-drawn guns at home should not be taught to drive six-wheelers as well. In any case the probabilities are that when the artillery of the Territorial Army at home is mechanised, as eventually it must be, its machine will be a six-wheeler and not a dragon.

As regards mechanised machine-gun battalions, they are at present in their early infancy; only one exists in England and is not yet out of the cradle. If more of these units are to be formed there is no reason why they should not be equipped with six-wheelers. I am, however, of opinion that they are but of sporadic growth, and it will be found that the light tank transported on a six-wheeled lorry is tactically a far more useful weapon than the ordinary Vickers machine-gun carried in the same vehicle.

For purposes of supply there can be little doubt that, viewing the question from all aspects, namely, production, maintenance, repair and use, the six-wheeled lorry at present possesses many advantages over tracked and semi-tracked machines. First, it is a commercial vehicle, and secondly, the wheel for many years to come is likely to be a more perfect means of movement than the track, its life will be longer, and its repairs simpler and more generally known.

The conclusion is that the time has now arrived for the General Staff at home and in India to put their heads together and agree upon a definite policy of mechanisation which will suit both European and Oriental tactical and administrative requirements. The six-wheeled, or multiple-wheeled lorry is the starting point, because for supply purposes complete coincidence exists between home and Indian requirements. The next point is to settle on the type of mechanised artillery suitable for both theatres. If it is found that dragon-drawn, or transported, guns are necessary in European wars and unsuited to Oriental, then our artillery drivers must be given a dual course of training. So also with tanks. If the Vickers tank and similar machines are, as I think, essential for war in the West but unsuited for war in the East, then two types of tank will be required—a heavy and a light—and drivers must also be given a dual training. In my opinion, in any case, the light tank will be required by the army at home. I will now examine this question, as it forms the axle pin of my argument.

To-day, infantry, except in mountain warfare, are incapable of carrying out an attack unless supported by tanks or large numbers of guns. This was proved conclusively during the Great War. The difficulty is the bullet-rifle and machine-gun. As a rule, and this may also be proved by studying the infantry attacks of the last war, when a hostile machine-gun opens fire the infantry attack halts, and tanks, or field artillery, are called into action. To ask a Vickers tank to destroy a machine-gun, it seems to me, is somewhat like asking an elephant to stamp on a scorpion. Besides the tank may not be at hand, and to be at hand it should belong to the infantry. If the gun is asked to take charge, time is lost in bringing it into action. It will almost certainly be well in rear of the infantry, and normally it is confronted with many difficulties before it can locate its target. If the machine-gun is replaced by a hostile tank, the field gun is next to useless, unless it can be brought close up to where the infantry are, and the infantry are helpless unless supported by the gun, or equipped with anti-tank machine-guns. If so equipped they find the greatest difficulty in carrying them. To render them mobile, these weapons must be placed on small mechanical vehicles which can move with the infantry firing line. This introduces the light tank.

With such a weapon the value of infantry is enormously enhanced. They can now deal with the enemy's machine-guns without calling upon heavy tanks and field guns to support them. They have also a fair chance of protecting themselves against hostile tank attacks.

For European wars the light tank will have to be equipped with heavy and light machine-guns; it is, therefore, of importance that both these weapons should be of the same type, and that the gun-mounting in the machine should be similar for both. Thus, if the Vickers machine-gun is to continue, then the anti-tank machine-gun should be a Vickers heavy machine-gun and not a Browning, etc., otherwise training will be complicated. If in India, anti-tank machine-guns are not required, then all light tanks can be equipped with their lighter counterparts. Consequently there need be no essential difference between the organisation of light tank companies in the home and Indian armies.

Yet another problem must now be examined. I have mentioned the importance of smoke in the attack on villages and towers. In a European war smoke is just as important in order to protect the approach of the light tank. I suggest, therefore, that a proportion of these machines be equipped with fifteen-pounder mortars firing smoke shell. Excluding the section commander's tank, I consider that the ideal light tank section is one organised into three tank squads, or sub-sections, of 2 light machine-gun tanks, 2 heavy machine-gun tanks, and 2 mortar tanks. Thus armed the section can protect itself by smoke, and attack either infantry or tanks. All these machines, whether in the home or Indian Army should, I maintain for reasons already stated, be carried on six-wheeled lorries. The only probable difference between the home and Indian machines being, that whilst in field warfare the light tanks should be roofless, in mountain warfare they should be roofed. This is a small point, for all machines can be so constructed that an armoured pent-roof can be slotted on to them.

I will now turn to the problem of maintenance and repair, as it forms the foundations of all tactical efficiency.

Right through the war it was the crucial problem of the Tank Corps. Right through the last nine years of peace which have followed the war, it has remained the crucial problem. Curious as it may seem, though it is obvious that a battalion of infantry is next to worthless unless the men are fed, it is persistently over-looked that tanks are worthless unless supplied with spare parts. In the war hundreds of tanks were sent out to France without a single spare part accompanying them. What was the result? Tank-cannibalism—machines fed on their like. If India is going to mechanise her army, whether the supply or fighting side, or both, may I suggest this to her General Staff: Think in terms of repair before you think in terms of tactics or use. Remember that every machine lives on spare parts. If you are going to spend a crore of rupees on machines, divide this sum in two and spend half of it on spare parts. Never in the history of the Tank Corps at home has there been a sufficiency of spare parts. Even to-day cannibalism continues, and to the mechanically-minded it is as revolting to see tank feed on tank, as it is revolting to the man in the street to see human beings devouring each other.

To conclude: My visit to India convinced me of many things: That not only is the tank as essential to military perfection in the East as in the West, but that opposition to it is founded on a bubble. I found the mountain warfare expert to be as hollow a fraud as his brother, the infantry expert, at home. The problem of the Frontier is essentially a mechanical one, though not necessarily a tactical one. The most economical way of conquering the Frontier is not by rifles and tanks, but by motor lorries. Two hundred years ago Scotland was a fastness of Pathans; to-day, mainly thanks to the road, it is largely a country of engineers. If the present road policy is continued, I should not be surprised if in a generation from now it will be found as safe to travel through Waziristan as it is to-day through the Punjab. Let the lorry conquer the Frontier, then the one great problem of the army in India will be war on the plains. In such wars rapidity of movement is everything, therefore the army in India must mechanise. To-day India is agricultural, but the motor road will make her industrial, consequently her mechanised army will possess a home base of supply. The final problem is now reached, for in industrial countries mechanisation is a certainty, as certain as was the eventual mechanisation of the Navy in 1840, when steam power began to transform the mercantile marine. The final problem therefore is: Not should the army be reorganised on a mechanical basis, but when should this reorganisation begin? Seeing that the whole of Asia is in turmoil, there can be but one answer to this question, which is *fiat instanter!*

CHAPTER XIII.

THE INFLUENCE OF TANKS ON THE ENCOUNTER BATTLE.(1)

Having decided that mechanised armies can be employed in practically all theatres of war, though obviously mountainous areas are less suited to their use, two major tactical problems face us: The first is the employment of tanks in the encounter battle, which is dealt with in this chapter, and the second is the use of these weapons in retirement, which is examined in the next. In the present study, the difficulty of combining the old and the new arms is accentuated, also the importance of man-power to occupy a country as well as machine-power to break down opposition.

Part I.

Argument.—In this paper I intend to deal with a speculative problem—the influence of a fast-moving tank on existing tactics and organisation. It is a problem which has not been studied, except by a very few, and it is an immense problem. In order to bring it within reasonable scope, I intend to limit my speculations to an encounter battle between two Continental nations—Red and Blue—each possessing 1 Cavalry Division, 6 Infantry Divisions, and 7 Battalions of tanks. In the Red Army the Tank Battalions are an integral part of each Division, in the Blue they are Army Troops. The tanks with which these two armies are equipped, I will suppose, are proof against armour-piercing bullets, possess a maximum speed of 20 miles p.h., and weigh about 10 tons.

I will now lay down two postulates:

(i) The *arme blanche,* the bullet and wire are useless against tanks.

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(1) *The Royal Engineers' Journal,* December, 1923.

(ii) The tank is useless in thick woods, swamps and on the slopes of mountains.

Accepting these, and that two-thirds of the theatre of war is open agricultural country, I will consider some of the possible problems which may arise under the headings of Approach, Contact, Deployment, Battle, Counter-attack and Pursuit.

Approach.—First, remember the nature of the tank organisation of both sides; and secondly, imagine that war has been declared between the Red and Blue nations.

Red moves off in column of march. Its tanks, in most cases, have been distributed down to Brigades, for the Red C.-in-C. is a firm believer in close co-operation between tanks and infantry. Before the columns have gone very far there is a considerable amount of confusion. The tanks want to go eight miles an hour, the infantry will not go more than two. The tanks are turned off the roads into the fields, but their commanders find that delays occur and control is lost when they are confronted by streams, woods, thick fences, broken ground, etc., and so they look for spare roads on their flanks. They use these and poach on the communications of neighbouring Divisions. Much abuse follows, and eventually they are withdrawn and placed behind their respective formations. A day or two later the Division cannot get their supplies up. The tanks are blamed—they block the roads. Besides, some Blue armoured cars have put the "wind up" one of the Advanced Guards, and have shot a Brigade

Commander whilst at breakfast, five miles behind the leading troops; so it is decided to put the tanks in front, and the Red C.-in-C. issues orders that they are not to become engaged without infantry support.

Blue moves off in column of march, one central road is allotted to its seven Tank Battalions, the Divisions marching on parallel roads. When air reports inform the Blue Divisional Commanders that the Red forces appear to have their tanks in front, they become jumpy, and urge the Blue C.-in-C. to give them tanks. He refuses, and, quoting Ludendorff, tells them that the infantry "must rely on their nerves." If attacked, they "must move to a flank." He will support them when he sees fit. He is a man obsessed by the idea of "the manœuvre mass."

Contact.—The Red Cavalry Division is operating well in front of its infantry, and is supported by a Battalion of tanks. These machines enter the Blue villages, terrorise would-be *franctireurs,* then along come the cavalry. When the ground is broken and difficult, the tanks stick to the roads, and the cavalry canter out on their flanks, and the advance proceeds rapidly.

One day the Blue cavalry are sighted. The Red Commander does not know whether they are working with tanks or not; he is, however, suspicious. He calls up his tank Commander and they consort a plan.

"You see those woods to your right and left," says the Cavalry General, "well, get into them.

I will go on with the bulk of my force and engage the Blue Cavalry; there will be no charges, but instead, directly we are in contact, I will fall back across the fields between the woods. Once the enemy is well between them you will attack him at top speed. If possible, I will wheel round the woods and attack all I can in flank. Do not attempt to co-operate with me, but seize your opportunity, and, when you do, hit hard."

The Blue Cavalry advance with caution, they have heard that tanks are about, and are much relieved when the Red are met without them. The Red troopers fall back, and the Blue push on. The Blue attempt several charges, but are beaten back by machine-gun fire. The Red fall back on the two woods, and then further back still. As the Blue approach, 60 tanks move out at top speed—some 18 miles an hour—and the best part of a Blue Brigade is wiped out. The fugitives retire in panic, and do not draw rein until they reach their infantry advanced guard, which they demoralise with the wildest of rumours.

That night the Blue outposts are most unsteady. Every sentry sees tanks. Wild firing takes place, and the outpost reserves stand to arms throughout the night.

Deployment.—The Red Cavalry have mysteriously vanished. Except for a few isolated sections of troopers nothing can be seen of them. The Blue are still completely demoralised and their horses useless. The advanced guards are in contact, both sides are deploying.

The Red C.-in-C., a man of methodical habits, is not going to rush the enemy. Under cover of his tanks he intends at first to deliver a frontal infantry attack with four divisions, and turn the enemy's left with two. With these two divisions he would like to use more than two battalions of tanks. His Tank Battalions are, however, distributed; to withdraw one or more will create confusion, further it will seriously affect the *moral* of the infantry who have learnt to rely on them. To withdraw individual companies is difficult. He must have some reserve force for his right flank, so he determines to withdraw one Division into reserve. He is very much annoyed at this change forced upon him through the difficulty of separating tanks from the other arms when close co-operation has become a recognised necessity.

The Blue Army is deploying rapidly, but the seven Tank Battalions on the central road are causing much confusion. The Blue C.-in-C. orders two of these battalions to join the Divisions on their right and left, and five to move to the right flank as an independent force. As the tank movements are to be kept secret, the machines must move out laterally, well in rear of the infantry and under cover of darkness. As they cross the various roads, the artillery and transport columns are delayed, and as night deepens confusion increases, the tail ends of columns trying to catch up with their heads after the tanks have passed by.

Battle.—The Red Army advances whilst the

Blue is still deploying. The Blue troops are in a nervous state, particularly the infantry, and are seeking to take up anti-tank rather than attack positions. Their attitude is defensive. Several of their positions are in woods and on hilly ground. These clash with the positions the Blue gunners would like them to take up in order the better to support their attack. Co-operation is difficult to establish. The Blue infantry start digging in, though not a shot has yet been fired.

The Red forces continue their advance. In many cases the infantry have thrown away much of their equipment in order to keep up with their tanks; the number of stragglers is increasing.

The two battalions of Blue tanks which have been allotted to the Blue Divisions have been pushed out well ahead of their infantry, and for the most part are out of sight. The two tank forces meet, and long-range fire opens. The Red guns are pushed up at a gallop. The Red Tanks, which have been ordered to keep close touch with their infantry, want to push on, but cannot; a good many get hit. Besides, the Red tanks are scattered on a wide front and are unable to concentrate against the Blue.

As the Blue tanks advance, the Red infantry opposite them break and stream to the rear. The Red gunners stand to their pieces and knock out several of the Blue tanks, but not many, as their speed makes them difficult targets.

The Red tanks move forward at the request of their infantry, and soon lose touch. Then, as one

Tank Battalion tops a rise, they see thousands of Blue infantry streaming away in the distance. All Red tanks are now moving rapidly forward, with every gun firing. The ground is littered with infantry equipment; Blue infantry are seen in all directions. Hundreds are caught up and shot down. The Blue gun positions are approached, some Red tanks are knocked out, but in a few minutes the tanks are on the guns, and the gunners, where they can, join the fugitives.

The Red tanks, pursuing the Blue infantry, have lost all formation.

The Red infantry, on the flanks of the penetration effected by the two battalions of Blue tanks, have fallen back and are seeking refuge in woods and villages and behind streams. With great difficulty the Red C.-in-C. collects some 60 or 70 machines and orders them to follow up the Blue machines which are manœuvring to avoid the Corps and Army Artillery. He is successful; a number of Blue tanks are shot down, and the remainder, in attempting to withdraw come up against a small river, and being unable to cross it surrender.

In rear of the Red Army there is terrible confusion. Bad news has travelled swiftly and several of the supply columns are in panic.

Counter Attack.—The Blue C.-in-C. hears of the total rout of his infantry. Scarcely a company remains intact, for his reserves have joined in the *sauve qui peut*.

Simultaneously, he hears that his communications have been attacked by hundreds of tanks—fear magnifies numbers. This attack has been carried out by the Red Cavalry Division and its battalion of tanks. The night before, they moved 25 miles to the left flank of the Blue Army and then inwards. The whole of the rear system of the Blue Army is in confusion.

The only force the Blue C.-in-C. has intact is five battalions of tanks. These are well out on his right flank, preparatory to attacking the left flank of the Red Army. He withdraws them to a river slightly in rear, a stream which runs at right angles to his original line of advance. He does so because by air he has learnt that great numbers of Red tanks are attempting to cross it. He wheels his five Battalions inwards and they sweep down the river.

The Red Tanks are surprised and taken at a terrible disadvantage. Some try to cross the stream and are ditched, others to withdraw, and are shot down, a few get away.

The Red C.-in-C., hearing what has happened, recalls his Cavalry Division. The horses are dead-beat, and some of the tanks are running short of petrol. That evening but a remnant of the force rejoins him. Simultaneously he learns that the greater part of his infantry are in flight. Rumour has it that they have been attacked by thousands of tanks, and that Battalions are surrendering wholesale. As darkness falls, the roads are blocked by streams of fugitives. Panic is now in command; even familiar sounds, like the noise of a motor-cycle or the droning of an aeroplane, send mobs of men scattering across the fields in the dark. Except for the five battalions of tanks, under the Blue C.-in-C., there is not an organised body of troops on or near the battlefield.

Pursuit.—The Blue C.-in-C., orders a relentless pursuit. Then he counter-orders it, for his supply services are in chaos and he cannot get up petrol for his machines. He cannot get rations for his men, he does not know where his men are, he does not know where his rations are; all he knows is that most of his lorries are overturned in the ditches and that their drivers have disappeared.

The condition of the Red Army is still worse. Hungry men start marauding, marauders soon become brigands. The peasants take to arms in self-defence. The Red Government goes down with a crash, and is replaced by a patriotic but revolutionary assembly.

The Blue C.-in-C. withdraws his five Tank Battalions; re-establishes his rail-heads and assembles the equivalent of some two Divisions of infantry. He begins to advance on the Red capital. He enters it only to find that, as a political centre, it has vanished, and that the people have taken up arms. Everywhere he is met by an intangible foe. Rails are torn up, bridges destroyed, and water poisoned. His tanks are invulnerable, but with 300 machines he cannot control an entire nation. Directly the tankmen get out of their machines they are shot at. His small force of infantry can just keep one line of railway open, and, except for this line and the capital, the country is unconquered.

At the opening of hostilities six Divisions of infantry might have won through. Now he wants at least twelve, possibly eighteen for police work alone, as well as hundreds of tanks and armoured cars. His country cannot supply them, and, whilst its Government is scratching its head, President Wilson descends in a parachute from a giant battle plane, patches up peace terms and Red and Blue lands have lived discontentedly ever since.

Part II.

Apology.—I must now apologise for the behaviour of the opposing Commanders-in-Chief. In place of criticising their tactics, I will examine their difficulties. Both had been brought up in a certain school of thought. Both had been educated on Training Manuals which they were not allowed to contravene. In the Red Manual the Commander had learnt: " To seize and hold a position with infantry remains the only known way of destroying the enemy "; consequently when tanks were given him, he looked upon them as handmaids to the infantry attack. In the Blue Manual, the Commander had learnt that shock is the decisive factor, so he, consequently, acted as he did.

Now, in my opinion, the initial mistake committed was that both these Commanders could not divorce themselves from particular points of view. A hundred years ago there were three arms—infantry, cavalry and gunners. To-day, we have a multiplicity of arms which are not infantry, cavalry or gunners. Why not, then, change our system of thinking, and think in terms of close combat troops (the new infantry), protective troops (the new gunners), and pursuit troops (the new cavalry)? Then examine each group, pull out the weeds and organise each so that each can co-operate within itself, and later on, perhaps, all three groups can co-operate with each other. Do not let us bother about holding ground or conquering ground—let us organise movement; this is the crucial problem. I will now examine each phase of the above encounter battle.

Approach.—Throughout the approach we see one outstanding difficulty, the difficulty of co-ordinating movement. Though tanks are roadless vehicles, when they are not fighting, their normal position is on a road, just as the infantryman's is. Man is a roadless animal, but if he has to walk from Aldershot to London he goes by road and not across country. If he has to fight an enemy along the way, he will often get off the road, but whenever possible he will get back on it. In fact, he only gets off the road so that he may get along it the quicker. With tanks we must do just the same.

The tank wants to go at eight miles an hour, and boils over if we try to make it go at two; the infantryman wants to go at two miles an hour, and boils over if we push him along at eight. As we cannot increase the marching-power of infantry we must produce a tank which can move at any pace without injury to itself. There is no difficulty in doing this. Then, if necessary, each company of infantry can have its own platoon of tanks, and there will be no need to place tanks in front or behind formations, or on separate roads. If armoured cars come along, they will be ready to meet them. Such tanks can protect infantry as long as they move at from two to three miles an hour. Have we solved the problem? No!

Contact.—Cavalry can move for very short distances at twenty miles an hour, or for fairly long ones at eight. Can these tanks and cavalry co-operate closely? No! Why? Because tanks are protected against bullets, and cavalry are not. The Red Cavalry Commander seems to have realized this, for he turned himself into a worm with the tank as the hook. If, in place of Blue Cavalry, he had met Blue tanks, I imagine he would have done very much the same thing. He would have used his cavalry as eyes, not as fists, and, if pursued, he would have scattered so as to reduce the target. He would, therefore, before he advanced, have settled on his "bounds" forward, and have selected various rallying points if he were forced to scatter. In fact, he would be ready to dematerialise his command at any moment, and materialise it again, anyhow in groups, an hour later, and well in rear or to a flank. "Dematerialisation" is the opposite of charging.

As long as tanks cannot move quicker than horses, cavalry will remain a useful arm.

A point worth noting in this contact engagement is, that if, in war, we can strike a crushing blow first, even if we only crush a small force of the enemy, we not only gain a physical victory over the force we have crushed but a moral victory over every man behind this force. The lesson here is that cavalry and tanks, when working together, must act with the greatest audacity and cunning. To avoid jealousies they should belong to one mobile arm—the pursuit troops. Pursuit does not necessarily mean waiting until an infantry battle has been fought. If we are mobile soldiers let us get the infantryman out of our heads and pursue whenever we can. Our object is not so much to "fix" the enemy, but to endow him with extreme mobility in the opposite direction to which he wishes to go. Why? Because by so doing we shall turn him into a demoralising projectile. We must always remember that the enemy has nerves.

Deployment.—Granted that the tank can, without detriment, move at the same pace as the infantry, deployment with tanks is no more difficult than deployment without them, especially if each battalion has a company of tanks of its own. In other words, we have dismissed the idea of infantry, and replaced it by that of close-combat troops.

But have we really solved the problem of deployment? No! What is this problem? Rapidity of movement. The tanks can move at twenty miles an hour, that is, eight times the speed of infantry. Twelve miles of infantry take a whole day to deploy; twelve miles of tanks will take two hours, perhaps less. What if the enemy detach an independent Brigade of tanks to attack us whilst we are deploying? Should we detach a Brigade also to attack the enemy's Brigade, and so cover our deployment, because we consider it essential that our close-combat troops must not exceed two miles an hour? Here, once again, we catch ourselves thinking in terms of infantry.

What if we have not got an independent Tank Brigade up our sleeve? Are we going to let ourselves be run over? Would not we detach every tank we could from our close-combat forces to frustrate such an ignominious end? What would the infantry forces say? Would they console themselves with the idea that they were the decisive arm, that they can hold and conquer ground? What would their *moral* be like when their tanks, not as a united body but as a host of separate companies, disappeared over the sky-line? What if their tanks were defeated? What if their tanks pursued the enemy thirty miles and defeated them? Are they going to double thirty miles to hold this ground? Or must their tanks abandon the idea of defeating the enemy and replace it by: "We must not go more than five miles or else our infantry will never catch up by this evening."

By enabling a tank to go two miles an hour, we may have solved some minor march problem. Why not, in place, mount the infantry in cross-country buses which can move with the tanks and at the same pace? Instead of marching twelve miles a day they will then move one hundred, and deployment will be proportionately rapid, and, if enemy's tanks are met with, the 'buses can fall back twenty miles in a couple of hours, and, if our tanks beat the enemy thirty miles ahead, the buses can cover the fifty miles in some five hours, and their occupants can hold whatever ground they like as long as their tanks remain close at hand. If their tanks move away, they can hold the ground against infantry. But is it likely that the enemy will attack them with infantry when he can make certain of victory by attacking them with tanks. If he does so, then the infantry will get into their 'buses and bolt. Their power does not rest in holding ground, but in ability to abandon ground, and abandon it at a speed equal to that of the tanks.

Battle.—I will now turn to the battle. Why was it such an appalling chaos? The main reasons were because the tanks were bullet-proof and could move at twenty miles the hour, whilst the infantry were not bullet-proof and could not move at more than four, when in flight. Had they been provided with cross-country 'buses, most could have saved their lives, but what use would they have been as close-combat troops? None, except in areas in which tanks could not move.

Either in 'buses or on foot, infantry offer no protection to the guns in rear against a tank attack. If overrun by tanks, their supporting gunners have to fire indiscriminately on friend and foe. If only the guns could be placed in front of the infantry, how much safer would the infantry be! This can be done by putting the guns on tracks. For a moment I will examine this question of artillery.

In the recent war, tanks, which could move at four miles an hour, had to attack positions held by hundreds of guns. Many tanks were hit, yet in spite of all these hundreds of guns, every well-organised tank battle was a success — an overwhelming success. To-day, we have only seventy-two guns in a division, and, in spite of the fact that some of them possess split trails, are they going to be as successful against tanks moving at 20 miles an hour as the German non-split trail 77's were against Mark IV and Mark V tanks?

Had the guns of the Red and Blue artillery been mounted on cross-country tractors, or in tanks, they could have protected the Red and Blue infantry. The object would not, however, have been to effect this protection, but to destroy the enemy's tanks and tractor-mounted guns. The field-gun motorised is, in fact, no longer a protective arm but a close-combat weapon.

Counter-attack.—The Blue counter-attack succeeded not because the Blue C.-in-C. had an organised force of tanks in hand, but because this force was homogeneous; it did not include arms which it had to protect but which could not protect it. The Blue C.-in-C. made full use of ground, not as cover but to restrict the mobility of his enemy's machines. He waited until they were hung up by a river and then attacked. This may seem a small point, but it is a most important one. We have been trained to appreciate ground from the point of view of cover and of fire effect. In the future we must also appreciate it from that of tank mobility. All our war maps will have to be changed. They will have to be coloured showing where tanks can go, where they cannot go, and where it is difficult for them to go. What we shall require in the next war are maps on the lines of sea-charts.

Pursuit.—Why did the Blue pursuit "peter out"? Because the Blue Army's supply system had gone west. To a mechanical army, its lines of communication are more vital even than those of a non-mechanical. This can be partially overcome by oil and gas producer plants, but as long as tanks are driven by petrol, communications must be safeguarded or else fleets of "tramp" aeroplanes must be created to convey fuel to them.

And now as to the last question. Why had President Wilson to parachute out of the heavens like a falling Lucifer? Because, though armies can be defeated by machines, nations cannot be, except at a stupendous cost. To keep a nation in order we want men. Men who move everywhere, who go into houses, and who can disperse meetings without bloodshed. To control a nation we want "human touch"; to conquer a nation we must establish order. When a nation rises, God help us, and to prevent its rising we must organise success, and not merely gain victories. To organise success we want men, and the quicker we can move these men about the less likely are the people to revolt.

Part III.

Conclusions.—In my Apology I stated that a hundred years ago there were three definite arms—infantry, cavalry and artillery. In the 14th century there were archers, pikemen and knights. Wellington did not think in terms of archers, pikemen and knights, and he was right. To-day, we have new arms and we also must cease thinking in terms of the old. We are not certain of these arms; let us try to group them in the three essential groups.

(i) *Close-Combat Troops.*—Tanks, motorised field and medium artillery, and motorised infantry, the last for attacking regions unsuited to tank action and for outpost work.

(ii) *Protective Troops.*—Motorised heavy guns and infantry pioneers. The latter to be used mainly on the lines of communications to build and garrison anti-tank blockhouses and to lay mine fields. The duty of these pioneers is to hold ground, and they should be equipped to do so.

(iii) *Pursuit Troops.*—Cavalry, as long as they are useful; fast, lightly-armoured tanks and scout tanks, also aeroplanes.

Behind this army of conquest will advance an army of occupation and of administration. It will consist of men, and it will hold the countries won by organising tranquillity within their boundaries.

Now I will conclude this paper by saying that I entirely agree with the F.S.R. when it tells us that infantry is still the decisive arm. I agree, because if we went to war to-morrow we should not possess sufficient tanks to wage such a battle as I have described. As long as we have no tanks we must rely on infantry. If a great war broke out to-morrow, I believe, because of the enormous number of machine-guns which now exist—five hundred to a Division in place of twenty-four as in 1914—the war would go static at once. Behind a wired machine-gun wall great tank forces would be created. How would they be organised, this is the question? Would we think of them in terms of infantry, cavalry and artillery?

Of course we would, unless we had troubled ourselves to think out their values in other terms.

This, then, is the gist of my paper.

We must be loyal to the present, because we live in the present. Do not, however, let this prevent us from being loyal to the future. To be disloyal to the future is to imagine that the present cannot change. It *will* change, and in terms of our ignorance or forethought.

CHAPTER XIV.

TANKS IN REAR GUARD OPERATIONS.(1)

Whilst in the last chapter the tactical problem of the encounter battle was mainly considered from the point of view of relationship between arms, in this chapter the problem of rear guard operations is examined from that of the influence of ground upon weapons. Ground is the controlling factor of movement, and the secret of future tactical success is to be discovered in the correct use of weapons according to ground.

1. *The Principle of Security.*

In rear guard actions the governing principle of war is that of security, secure movement being the object of a force in retreat. To gain this security it is necessary to delay the pursuing enemy, consequently rear guards must possess a high and flexible offensive power.

The object of a rear guard is to gain time, it accomplishes this not only through fighting but through threatening to fight. A pursuing force, it must be remembered, is seldom numerically a strong force, frequently it is a tired force, and more often than not it is partially disorganised. Its *moral* may be high, especially so if the pursuit follows on an important victory, but it must be remembered that unless *moral* is firmly established on a stable organisation, it is subject to rapid fluctuations. This being the case, a rear guard commander should always attempt to attack the nerves of the pursuing enemy, that is to say, he should at every turn attempt to gain his object by means of surprise. The importance of this becomes apparent if we compare the conditions in which delaying and pursuing forces have to work. As regards the first, every minute isolates it more and more, for its main body is moving away from it; as regards the second, every minute is bringing assistance closer to it. Consequently, concentration of force is difficult for a rear guard, whilst for a pursuing force it is comparatively easy. Hence to economise his strength a rear guard commander must mainly rely on surprise, that is, on the moral attack. This demands a high order of leadership. For this form of attack conditions are in his favour, as in a game of hide and seek. He can generally select his positions, but the pursuer has to seek him out; he has to penetrate into the unknown, and if his temerity is repaid by a severe rap on the knuckles the *moral* of his men will rapidly be lowered, and the lower it falls the slower will be the pursuit. I mention this because I believe surprise to be even a more potent weapon in retirements than in attacks. But surprise must be immediate, it must be a sudden and unexpected flash, and then, whilst the enemy is bewildered, under cover of his bewilderment a rapid withdrawal must be made and a new surprise mounted.

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(1) *The Journal of the Royal Artillery,* July, 1925.

2. *The Conventional Rear Guard Action.*

The conventional idea of a rear guard action is somewhat as follows: The rear guard halts, takes up a position, forces the enemy to deploy, then it falls back and repeats this action. By forcing the enemy to deploy, time is gained. However excellent this procedure may appear on paper, in reality it seldom takes place. In reality, what we normally see is a weary force of men falling back more or less anyhow, some fighting it out to the last, others legging it for all they are worth. Nobody knows, even approximately, what is happening, or whether their flanks are covered or uncovered, or where their headquarters and first line transport are. What is the reason for this sorry state of affairs? The reason is a very simple one. Movement is based on leg-power, and leg-power limits every action of the soldier, especially so in retirements, when every minute is isolating the rear guard more and more. Leg-power reduces the soldier's *moral* by fatiguing him; it prevents him remaining over long in any one position; it does not enable him to keep close touch with units on the flanks of his own; it demands that he should keep close to his cookers and ammunition; it, in fact, limits his action to such an extent that the conventional picture of a rear guard engagement is the exception and not the rule. If the rear guard actions of the last war are examined, it will be found that four out of every five were chaotic, and that the pursuer was delayed not because he was forced to deploy, but because his leg-power would carry him no farther.

3. *The Influence of the Tank on the Conventional Idea.*

During the war, very few tank rear guard actions were fought, but from those which were, two facts are outstanding. The first, that when tanks counter-attacked, the enemy were thrown into a panic; and the second, that on account of the slow speed of the machines and their short radius of action it was most difficult to withdraw tanks any distance in face of field artillery. The weak point in the tank was that it was slower than a horse-drawn field-gun. This difficulty has to-day been overcome, for the Vickers tank possesses a maximum speed of 16 miles an hour and a circuit of about 100 miles.

Remember the picture—infantry, artillery and cavalry falling back and persuading infantry, artillery and cavalry to deploy. In this picture place the Vickers tank. It is no good deploying infantry and cavalry against tanks, consequently, if the pursuer deploys anything, it will be tanks and artillery. Once he has deployed them he will probably maintain them deployed, certainly his tanks, and will continue to attack with them until the resistance of our rear guard is broken. If the enemy does this, it is no good reinforcing the rear guard with cavalry, in place we shall have to push up tanks and artillery, and if we find our infantry and cavalry of little use, we shall be wise to withdraw them to the main body. The conventional picture has now completely changed. We have a rear guard of tanks and artillery, and the enemy has a pursuing force of the same weapons. Behind the enemy's pursuing force is advancing a muscular army which can take little part in the action; in front of our rear guard is retiring a muscular army, the safety of which depends almost entirely on the endurance of its rear guard. If its rear guard is annihilated it is helpless, and yet it is equally helpless if called upon to support its rear guard. Meanwhile the rear guard action is nothing like the old conventional action, ploying and deploying, but much more like a naval action, especially so if the artillery on both sides is tractor-drawn or mounted. It is a running fight between two forces which are self contained for a journey of 100 miles, and these two forces can advance and fall back without using road. We have here quite another picture, and I will now examine it in detail.

4. *Aircraft and Cavalry in Rear Guard Actions.*

I will start with the assumption that the rear guard consists solely of tanks and tractor-carried guns. Before its commander can do anything he requires information:

First, where is the enemy and how is he distributed?

Secondly, where are our own troops?

Thirdly, what is the nature of the country?

Unless he can gather information on these three points he cannot maintain his object, namely, the delay of the enemy. His tanks are somewhat blind, and they cannot well reconnoitre the enemy's advance. Aeroplanes are much more suitable for this work, and also for maintaining touch with the retiring body. Therefore he must have aeroplanes, for they will help him to overcome the first two of the above difficulties.

Now as to the third. The aeroplane can examine the ground in bulk, but not in detail. It cannot descend into the middle of a forest and see whether tanks can move through it or not. It cannot reconnoitre a copse as a suitable position for an ambush. It cannot move about the country questioning the inhabitants. To use tanks for this purpose is to reduce your right hand punch, you must economise them, and this can be done by using cavalry. Not to charge and attack, but to scout and to see. Given an adequate number of aeroplanes and a force of well-trained horsemen, the rear guard commander's work is tremendously lightened, in fact, these two arms to-day are essential to skilful rear guard work.

5. *Infantry in Rear Guard Actions.*

I will now assume that both the rear guard and the pursuing force have aeroplanes and cavalry as well as tanks and guns, and that, after three or four days' retirement, a hilly and wooded country, such as the Ardennes, is entered. Here a stand is to be made until the main body can get through the defiles. Ground suitable for tank and artillery action is limited, in fact, a great number of these weapons might prove rather a hindrance than a help. The rear guard soon gets involved, and the tanks, mainly occupying the roads, are open to infantry annoyance and are particularly vulnerable to mountain artillery. The reason for this is that, though it is not difficult to hold a defile with tanks and field guns against tanks and field guns, it is difficult to command the intervening spaces between the defiles. For mountain warfare, infantry and mountain artillery are required, also are they required for tank warfare in hilly, swampy and thickly wooded country.

Here we come to another difficulty; if we allot infantry and mountain artillery to our rear guard for operations in country unsuitable for tanks, though in this country they may be of the greatest assistance, in open and good tank country they are not only of little assistance, but a veritable hindrance. Why? Because they impede the mobility of the tanks and tractor-mounted guns, and by doing so they seriously reduce their tactical power. The one thing a tracked rear guard does not want to do is to convoy muscle moving troops. The only way out of this difficulty is to mount the infantry of the rear guard in cross-country 'buses, and if a mountain gun cannot be invented which can be man-handled up hills and through woods, there is nothing for it but to put the mules into tracked conveyances. A little while ago I stated that it was no good deploying infantry against tanks, and I adhere to this statement, for in hilly country, if you have infantry, and if you use your infantry on the hills and not in the valleys, you will not be deploying them against tanks, but in areas free from tanks, and areas in which they can both annoy the mechanical forces in the valleys, and engage, on equal terms, troops similarly equipped to themselves.

What should our ideal rear guard consist of? I think of the following arms:

- (i) Fast moving tanks and armoured cars.
- (ii) Fast moving tractor-mounted guns.
- (iii) Aeroplanes for distant reconnaissance.
- (iv) Cavalry for close reconnaissance.
- (v) Infantry and Sappers carried in cross-country buses.
- (vi) Mountain artillery which can be man-handled.

Having arrived so far, I will now consider the tactics of such a force.

6. *Tactics in Open Country.*

I will imagine that a battle has been fought and that we have been defeated, and are forced to retire. Here is a complex situation, in which the first problem is the establishment of a rear guard. In my opinion, the rear guard should be formed not out of the battle front, but out of the reserves, and well in rear of the battle front; and the tanks of the rear guard should be so placed that they can attack in flank hostile forces held in front by artillery fire. Before this can be done the map must be consulted, and if time permits the ground in rear of the battle front reconnoitred. As a matter of fact, this reconnaissance should take place during or even before the battle opens. A wise man takes no unnecessary risks, and no general can say, at the opening of a battle, whether he is going to win it or not. If he has got to withdraw, a little foresight before battle may be worth a corps of fresh troops after a battle is lost.

The map should be chalked over in two colours, for instance—red where tanks can operate, and blue where they cannot, or find difficulty in doing so. Once the wheeled vehicles have been cleared back, the forward infantry should be ordered to retire over the blue areas; these will probably be roadless, and as the withdrawal is more likely than not to take place at night, unless the infantry have been trained for this work, and the staff know how to carry it out, it will probably end in chaos. Now as regards the red areas. In these the guns should take up frontal positions and the tanks flanking ones, or *vice versa.* In the first case the guns will attempt to hold the enemy's tanks and the rear guard tanks will attempt to take them in flank. In the second case the rear guard tanks will entice the enemy's tanks to advance so that the guns can take them in flank. Remember that in every operation you must have a left as well as a right hand punch, in other words, offensive action is based on secure distribution of strength; in the first case your guns are your base of action, in the second your base is your tanks. As the blue areas cannot be left unguarded, it is here that the infantry of the rear guard should be deployed with their buses conveniently at hand. The more automatic weapons this infantry are armed with the better, and if they are equipped with heavy machine-guns and portable land mines they will be able to do some damage to hostile tanks which come their way.

If the country is so open that tanks can cross it everywhere, then in place of dispersing the tanks they should be concentrated in strong groups whilst the guns should occupy as wide a front as is tactically sound. The guns will then be able to hold the enemy's machines at a distance, whilst the tank groups manœuvre to attack them. (I naturally cannot enter into all the possibilities of open country fighting, but I think I have dealt with the main problems.) Whilst this action is being fought out, the cavalry and sappers should be well in rear reconnoitring the country and preparing demolitions, and the armoured cars well on the flanks attacking, or at least threatening the enemy's rear. That these fast-moving machines should be armed with a light high-velocity gun is essential.

7. *Tactics in Hilly Country.*

I will now suppose that the rear guard has fallen back to a range of hills, such as I mentioned earlier in this lecture. Here it obviously becomes possible to divide the ground to be held by the rear guard into areas suitable and unsuitable to tank action. The tank areas will vary in width but will normally be narrow. The flanks of these areas will be very vulnerable because tanks and tractor-mounted guns are not suited to hill climbing, and if the ground is rocky it may be quite impossible for them to cross it. The danger of these exposed flanks is a two-fold one. First, if the enemy can occupy the hill sides with mountain artillery, the tanks may be destroyed; secondly, if he can occupy them with infantry, though the tanks cannot be destroyed by bullets, their crews risk being besieged in their machines. To protect these flanks, infantry and mountain guns must be used, and should be employed not only in order to drive the enemy's infantry and gunners off the slopes and summits of the hills, but to attack and raid his tanks and guns in the valleys below. As tracked vehicles are more influenced by the nature of the ground than infantry, in hilly areas, the demolition of bridges, and the blocking of defiles will seriously delay mechanical movement, consequently sappers must know exactly what types of obstacles will prove most effective. Breaking down a heavy tank on a narrow road may block it for several hours, and detonating a tank filled with explosives may prove, in certain cases, a useful expedient.

8. *Tactics in River Country.*

Until tanks are rendered amphibious, rivers will remain a definite obstacle to tank movement, and even if they are able to cross water, where banks are steep, or the land is swampy, rivers will still remain difficult obstacles to cross. At present the weight of a tank, and, consequently the thickness of its armour, and the size of its guns, is limited by the strength of the bridges to be crossed. Destroy these bridges and hold the river banks with machine-guns, and the construction of new bridges is seriously delayed. From the infantry point of view, a river forms the best of tank obstacles, for whilst infantry can generally cross rivers with ease, tanks can only do so with difficulty. If mechanical weapons increase, and amphibious machines are not built, rivers will undoubtedly play an increasingly important part in rear guard operations. In these actions I am of opinion that the river bank should be picketed by the infantry of the rear guard, and that the tanks and tractor-mounted guns should be distributed in two or more groups in rear of the infantry and flanking the most likely crossings. Directly the enemy has effected a crossing, the infantry of the rear guard should retire, the tractor-mounted guns should manœuvre so that they can open frontal fire on that portion of the enemy which has crossed, whilst the tanks deliver a flank attack. Or this operation may be reversed.

9. *Tactics in Wooded Country.*

The normal wood or forest is not a suitable area for tank movements; nevertheless woods form excellent places wherein to establish ambushes. In thick woods infantry are safe from a tank attack, but they can do nothing to prevent the enemy's machines moving round the woods and cutting off their retreat. Consequently, when infantry occupy a wood they should be supported by artillery, mainly located in the wood and on its flanks. If several woods are thus held, the tanks should be grouped in rear of the intervals between the woods, so that they may cover any dead ground and engage hostile machines which, driven away from the woods by the guns, seek to outflank them. In a wood possessing good rides there should be little difficulty in hiding within it a large number of tanks. This possibility should be remembered, for, as I have already stated, there are few operations so effective as a well placed ambush to delay a pursuer.

10. *Tactics in Towns and Villages.*

Towns and villages held by an enemy form bad tank objectives, but if held by our own troops they frequently form good tank areas. When a town or village has to be held, its outskirts should be picketed by infantry and field artillery, and tanks should be held in reserve, preferably in a central position, or, if the town is large, in three main groups—one central and one on each flank. If this is done, the central group can be used for street clearing operations, and the flanking groups for open action against the flanks of the enemy. It may sometimes be found effective to group the tractor-mounted guns outside the town and on its flanks so as to protect the line of retreat.

11. *The Importance of Ground.*

The subject of this lecture is a very complex one, and I have done little more than outline a few possibilities, and only tactical ones at that. In mixing mechanically moved weapons with marching troops, it must never be overlooked that considerable modifications will have to be made in administrative as well as in tactical staff work. As weapons move quicker, staff officers must think quicker, and unless they have thought out all kinds of possibilities beforehand, there will be no time to do so after an engagement has begun. Tactically you will not go far wrong if you remember two things. First, always study the ground, even if only off a map, and distribute your arms—infantry, cavalry, artillery and tanks according to the ground, and with reference to protection, offensive power and movement. Secondly, never forget that you have two or more arms under your control; tactical co-operation is mainly attained by making one arm the base of action of the other, acccording to the nature of the ground. Whatever you do, your left hand punch must be followed by a right hand one. A one-armed man will not make a good boxer, and any single weapon unsupported by another is at a serious disadvantage if opposed by its like co-operating with a second weapon which can protect its advance.

CHAPTER XV.

AIR AND LAND WARFARE.(1)

In chapter IX certain problems of air warfare were examined, and amongst these the influence of ground organisation on the true mobility of aircraft. This problem is more fully elaborated in the present chapter in order to show the complementary nature of mechanised warfare on the ground and in the air. The one is essential to the development of the full power of the other, and is in no way antagonistic to it. Without a mechanised army an air force can possess no secure base of action, and without an air force, a mechanised army is so restricted in vision that its full mobility cannot be developed.

1. *The Rivals.*

THE purpose of the three Fighting Services is to maintain the national will as expressed by Parliament; consequently, unity of outlook during peace time is the foundation of unity of action in war. To-day, I think, I am right in saying that there is a distinct and ever-growing cleavage between the strategical and tactical opinions held by the Royal Air Force and the Army, in spite of the fact that each Service fully realizes that its duty in war is to protect and to enforce the policy of the Government. What are the reasons for this difference of opinion, for opinion it must remain until the facts of the case are disentangled and analysed?

It is my intention in this article to examine this problem and to arrive at a solution, quite possibly not the correct solution, yet one which, I hope, will be sufficiently well founded to furnish a basis of discussion.

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(1) *The Army Quarterly,* July, 1925.

To begin with, I think it is necessary to go back to first causes, and the origin of this cleavage took form in August, 1914.

When the Great War opened, the aeroplane was in its infancy, and beyond assisting the Army to obtain information, its tactical value was small. The Army possessed no air sense, it had been educated and trained on methods which did not visualise air action, and though the air forced the aeroplane upon the soldier, he did not understand it as a separate arm, and he could not get out of his head that he alone, and especially so if he happened to be an infantryman, was the arm preordained to win the war. His opinions of himself were dogmatic in the extreme, he was the appointed agent of victory, and all other agents were made to assist him—his outlook was that of an Oriental despot. As regards tanks, he held similar views. They won battle after battle, and on ground which suited them no infantry could stand against them, yet to the infantry soldier it was he who conquered, and, even to-day, we are told officially that infantry is the arm which wins battles, that the other arms are only there to assist it, because battles are won by the rifle and the bayonet!

Here is to be found the beginnings of the cleavage—the arrogance of the infantry soldier, and the bulk of the Army is infantry, and this arrogance grates like grit between the teeth of the new arms, it annoys them to be belittled, and in their turn they stand on their dignity, and what is it worth?

The year 1918 saw some wonderful tank operations, and some equally wonderful air operations. The Royal Flying Corps, backed by popular opinion, became a separate Service—the Royal Air Force. To assert its manhood it clamoured for independence; it wished to show what it could do, for it was proud of itself. It would bomb Berlin to hell, and end the war. Had the war continued, it might well have ended it, because, after four and a half years of naval attrition and military attack, German *moral* had sunk so low that this bombing might have provided the last straw.

Peace, in place of closing, increased the cleavage. The Army clamoured for its own air force, so did the Navy, but popular opinion, stimulated by the memory of the German air raids, backed the Royal Air Force, and this Service grew arrogant. It claimed supreme control; it would have won the war had it only lasted; it could win the next war; it could wipe out armies and fleets, and so it came about that Whitehall boiled with rage.

The Royal Air Force had not won the last war single-handed; nevertheless, undaunted it set out to prove how it could win the next. It said: "Suppose the French have 5,000 aeroplanes and we have 500, and we are attacked by France, what will France do?" The answer is obvious—

she will bomb London. "Granted," says the Air Force, and then turning to Whitehall it asks: "And what will you do?"

Whitehall sweats with anger, she can do nothing: our Navy can bombard the French coasts and land soldiers in Cochin-China—this is about our military limit. Popular opinion is startled; there lies France, but a cannon shot away, with a formidable air force and an army five times as big as our own. Popular opinion does not pause to consider that for many reasons a war with France is about as likely as a war with Paraguay. Such a war is, of course, possible, all wars are possible, but it is highly improbable, and though the *raison d'être* of the three Services is to meet all contingencies, probable ones, such as assisting France against Germany, or Germany against Russia, or of fighting small wars in half a dozen theatres, must not be lost sight of, simply because France has a preponderating air force.

Having scored this dramatic point, a considerable section of the Royal Air Force has now started to ride it to death. If the French can obliterate London, we can obliterate Paris, therefore the obliteration of capital cities is the object of war, since in these cities the will of the hostile nation can be attacked, and no navy or army can adequately protect it.

This reasoning is only partially true, because of the English Channel, and the smallness of the British Army. It is, however, not necessarily true in a war between two Continental nations, because Continental nations are not surrounded by water, and most of them possess large conscript armies. Before examining the nature of such a war, I will turn to the past and establish a strategical and tactical base to my argument.

2. *The Foundations of Strategy and Tactics.*

Two armies face each other in a theatre of war, between their respective fronts is a battle area, and in rear of them are two administrative areas. In these administrative areas are situated the whole of their internal organs, and these supply them with fighting energy. Immediately behind their fronts are their command headquarters, their supply columns, etc.; further back, depôts and railway centres; and further back still, arsenals, manufactories, the seat of government, and the will of the people they are fighting for.

A good general will attempt to discover the strong and weak points in his adversary's organisation and position, in order that he may concentrate his force against the weak, and distribute it to secure himself against the strong. He knows that his enemy's teeth are in his head and not in his tail, also he knows that, if he can stamp on his tail, he will force him to turn his head round, thus he will accomplish his object more economically by a rear attack than by a frontal one. If he can but threaten the enemy's flank or rear, he will force him to turn and protect his base and his lines of communication, without which his army cannot exist as an organised force for more than a few days. The hostile rear is his objective. His object does not change—it is to impose the will of his Government on the enemy's Government by defeating the enemy's army; but his objective is continually shifting its position. One day it may be on the Rhine, a few days later on the Meuse, and, later still, on the Aisne. He may never be able to get behind his enemy, but if he can, if he only can, he has got him "cold."

So far his strategy, and now as to his tactics. He has got to hit his enemy and he has got to protect himself, consequently, he has got to maintain his own mobility, so that he can follow up or move away from the shifting enemy.

He may have to hit his enemy in front, but he wants to hit him in rear, and to do so with any certainty, he must stop the enemy from moving, he must pin him down. If he can only do this with part of his force, he may be able to hit him in flank, or rear, with the remaining part.

Like a boxer, he wants two fists, so that with one he can punch his antagonist to a standstill, and then knock him out with the other. He hits at him frontally to fix him, and, when once fixed, he manœuvres round his other fist to knock him out; or he fixes him by a flank attack and knocks him out by a frontal one. His ability to manœuvre—to move—enables his two fists to co-operate, and if he can surprise the enemy by a blow on the nape of the neck, he has got him "cold."

At sea it is just the same, the principles of strategy and tactics are identical, only their application varies. I will now turn to an air force and see if in air warfare these principles do not also apply.

3. *The Foundations of Air Warfare.*

In the case of an air fleet operating against a similar fleet, the strategical and tactical principles I have outlined for land warfare visibly hold good; their application is, however, more elastic. On land, an army is a slow-moving instrument connected to its base by lines of communication—roads, railways, etc., with a navy these lines become plain surfaces, and in the case of an air force—cubic spaces. In all three cases, the base remains the same, for each force operates from the land, and, consequently, can be attacked on land; it is the communications and degrees of movement which differ, for whilst soldiers are normally forced along a line and at low speed, ships can, so to speak, move in circles and still protect their communications, and aircraft can convert these circles into spirals. Strategy has not radically changed, but in some respects it has become simpler, and in others more complicated. Nor have tactics changed, for aircraft, like ships or battalions, have got to move, to hit and protect themselves, and their mobility largely depends on protection and hitting power.

The destruction of the enemy's air fleet is to-day the primary object, as this will lay bare the enemy's nerves. The paralysation of his will is the next step, and if it is gained, either through a direct attack on the nerves of the civil population, or by the threat of such an attack, the last and ultimate step is the occupation of the enemy's country, for without this occupation it is most difficult to assure his complete surrender.

Occupation demands an army, or a police force. Its utility, after air supremacy has been won, is beyond dispute; but how far is it possible for an army, as organised to-day, to operate successfully against an air fleet working independently of any land force? This is, of course, an extreme case, yet I will examine it, as I think we shall discover certain facts which are worth discovering.

An army cannot protect the will of its nation against air attack, and an air fleet cannot fully protect its base of operations against land attack. There are two crucial factors in this problem: the first is, the *moral* endurance of the people which is being attacked, and the second, the distance between the front of the army and the attacker's air bases. Which is going to crack first? The *moral* of the one side, or the ground organisation of the other?

We have few facts whereon to base the endurance of civil *moral,* but we can be pretty certain that, if a great city is thrown into complete disorder for a week, possibly less, the bulk of its inhabitants will be reduced to starvation, from human beings they will be transformed into wild beasts.

As to the second question, we have definite information, for we know the radius of action of a long-distance bomber. It is approximately 300 miles. If a modern army, even if it is unopposed, sets out on its feet to march 300 miles, it will take at least thirty days to arrive at its enemy's air bases; its intervention is, therefore, likely to be too late. If it moves in lorries, it can arrive in three or four days. If it is only slightly opposed it may take seven days; it is, therefore, touch and go which will crack first—the civil *moral* or the ground organisation? It may be granted, therefore, that a sensible nation will not attempt to secure its national will solely by an air force or an army. The air side will first ask for engineers to attack the enemy's mobility by road and railway demolitions, and then for some kind of land force which can protect its air bases. The land side will first ask for fighting machines to attack the enemy's bombers, and then for bombers to attack his civil *moral.* Thus we are back at our starting point, namely, where we are to-day, and the only new idea we are left with is the postulate that one side or the other must be prepared to attain a decision, moral or physical, within seven days of the outbreak of war. I call this a postulate, for I have not proved it; it may be eight days or ten, or twenty, or more, according to circumstances, anyhow it provides a hypothetical base to speculate from.

4. *The Contest between Land and Air.*

I will now turn to war as it faces us to-day, and, to avoid wounding the susceptibilities of other nations, I will suppose that war has been declared between Scotland and England. Scotland has a powerful army and a small air force, and England has a powerful air force and a small army. England's plan is to bomb Glasgow and Edinburgh to hell, and Scotland's is to advance into England at such speed that the English air bases will be driven south of the Midlands.

The English bombardment is opened on Glasgow and Edinburgh, and simultaneously a number of Scottish divisions cross the Cheviots unopposed. The bombardment continues, and six days later the marching divisions reach the Tyne, still a long way from the southern border of the Midlands. If the seven days' postulate be correct, England wins the war by air action alone.

For the sake of argument, suppose that the postulate is not correct, and that the Scottish columns steadily march southward, driving back the English aerodromes—the rear organisation of the English air force. Should this air force continue to bomb Glasgow and Edinburgh—the two great moral points of resistance in rear of the Scottish army?

The answer depends on which base is most seriously threatened. If, after seven days' bombing, Glasgow and Edinburgh refuse to give in, it may be concluded that England has miscalculated Scotch will-power, or possibly that the population of these two cities has been evacuated. In actuality, the probabilities are that, whilst at the very beginning of the bombing, the inhabitants of Edinburgh and Glasgow would have insisted on their small air force being tied down to protect them, when or even before the Scottish division reached the Tyne, the English people would have compelled their Government to stop trying to reduce the moral fortresses of Edinburgh and Glasgow, and, instead, order their air force to attack the advancing Scottish army. This demand, I think, is a sound one, and I now come to what I believe to be the crux of the problem, which is not simply a rear attack, but the locality of the rear attack.

At the opening of hostilities, Edinburgh and Glasgow are undoubtedly the correct targets; but as the Scottish army advances, the area in rear of it deepens, and as it deepens the number of possible targets multiply, and as they multiply the English air force is offered a greater choice, and it may find that an attack on the defiles across the Cheviots will halt this army quicker than continuing the bombardment of the moral fortresses. I do not say this is so, but I suggest that it may be so, and if it is so, by the time the Scottish army reaches the Tyne, it may be completely severed from its base, so completely that it is forced either to retire or surrender. If its severance is not so complete, there is, however, a good chance that the Scotsmen will be fixed on the Tyne. Once fixed, then bombing can once again open on the two moral fortresses in rear of them, and their surrender be enforced.

We see here not a new form of warfare, but an old form. In 1797, Bonaparte besieged Mantua, an important physical and moral point of resistance in the Austrian system of defence; but directly his rear was threatened he raised the siege and marched on Rivoli, because he knew that Mantua was a permanently fixed point, and that, because the Austrian army advancing down the valley of the Adige was mobile, it was to be feared far more than the stationary Mantua. He struck at the enemy's mobility, so should the English air force—first by hitting at Edinburgh and Glasgow, but if this does not fix the Scottish army, then at the Cheviot defiles, and if this does not succeed, then at the crossing over the Tyne, and so on. If this is not done, the Scottish rear area may become so deep that it will furnish a sufficiency of supplies in spite of pandemonium in Glasgow and Edinburgh. Thus, my view is, that as cities are permanently fixed points they should not form permanent aerial targets, only temporary ones; that is, as long as bombing them will deny mobility to the enemy main arm, whether it be his army, navy or air force. In brief, the lesson is: if you want to fix a man, it is legitimate to threaten his house if he is near it, but if he is a mile away, it is better to hit him, and, if possible, hit him in the back.

5. *The Superiority of an Air Force over a Modern Army.*

The above reasoning is mainly based on the soldier's point of view, and the wrath of the airman within me has just about reached boiling point, so I will now let the airman speak.

What is the good of laying down a postulate if it is at once to be set aside? I grant you that the postulate may be incorrect, but anyhow, let it be the controlling factor in our discussion, and then let us examine the likelihood of a modern army, badly supported by aircraft, operating against an enemy's air bases within 300 miles of its front and within the limited time of seven days.

A modern army is a slow-moving horde; it not only offers a vulnerable human target when on the line of march, but to advance at any speed (and its maximum speed is tantamount to standing still when compared to the speed of aircraft), it must be daily supplied by hundreds of vehicles carrying hundreds of tons of food and ammunition. This horde and its vehicles are tied to roads and railways, and not only can these be attacked from the air, but its movements are so slow—20 to 25 miles in a day at a maximum—that if a devastated area is created in front of it, that is if its forward lines of advance are attacked, this speed will rapidly be reduced and its advance will frequently "peter out." In fact, it is scarcely necessary to attack the horde at all, for the demolition of railway stations, junctions, bridges and roads will of themselves all but halt it.

What an air force requires is the support of a strong body of engineers, for such men will be able to gain the necessary time for prolonged air action, more quickly than far larger forces of infantry, cavalry and artillery. Once air attack succeeds, then all that the air force asks for is a police army which will enter the enemy's country and disarm his fighting forces. Should the enemy hesitate to comply, then once again his cities will be bombed from the air.

The truth is, that in any theatre of war of moderate depth, such as from Liége, or Metz, to Paris—a distance of 170 miles—by a systematic destruction of roads and railways a modern army of any size is likely to take at least three weeks (probably much longer), to arrive at Paris, and even without much air opposition; if, meanwhile, its rear is being plastered with bombs, the likelihood of large and well-organised formations ever reaching Paris at all is improbable in the extreme. An air force is, therefore, the superior Service, and when used on land the army is its handmaid.

6. *The Probable Solution.*

Such is, I think, a fair representation of the airman's views, and they appear to be founded on sound reasoning. He says: a fighting machine has a speed of 120 to 150 miles the hour, and a radius of action of 150 miles (that is, 150 out and 150 back); a bomber has a speed of 80 to 100 miles the hour, and a radius of action double that of the fighting machine; a modern army has a speed of 3 miles an hour, and it can march about 20 miles a day, and this distance can be reduced, not only by attacking the soldier and his supply vehicles, but also his base, if it is within 300 miles of the hostile aeroplanes. The crucial factor is not so much power to hit or to guard, but power to move. It is the superior speed of the aeroplane which has deprived a modern army of its strength—aircraft are, in fact, the forceps which have drawn the soldier's teeth.

If mobility is the crucial factor, let us examine it. In the case of the modern army, what is its true mobility? Twenty miles a day as long as its supply organisation can be maintained. In the case of an air force it is 150 or 300 miles, according to the machines used, as long as its ground organisation remains static. But if this ground organisation has to move, and it is moved in lorries, these vehicles, under war conditions, are not likely to cover more than 100 miles in a day; and if this ground organisation has to be dismantled, loaded on to the lorries, moved, unloaded, and re-erected, I imagine that a journey of 50 miles is all that can be expected, if it is vital to maintain a continuous air attack in maximum strength.

I will assume, therefore, that 50 miles a day is the true degree of mobility of an air force advancing or retiring, its tactical mobility being limited by its administrative mobility. In the case of an army it should be noted that the reverse is true, for its administrative lorries can move 100 miles a day and its marching columns only 20.

Now we know from experience that, if we provide the marching columns with lorries, we can move the whole force at 100 miles the day, that is, twice the distance attained by the true mobility of an air force. But we also know that a few blow holes and broken bridges will stop a lorry-carried army, and in some cases more completely than a marching one, for lorries are definitely tied to roads.

The road now becomes the governing factor in mobility; we must dispense with roads, and we can dispense with roads since a tracked machine can move across country. It will move down a road at 10 miles and more the hour, and when it comes to a blow-hole it will walk round it. A broken bridge will stop it, hence having got rid of the road as the governing factor we find the river replacing it. If now a proportion of our tracked vehicles—tanks, lorries, etc., are made to float, this last factor will in a considerable degree lose its power; and, at present, I can see no other factor which is likely to replace it. Tracked vehicles have already accomplished journeys of over 3,000 miles across country, and at an average speed of 120 miles a day, consequently, it is not asking too much to suppose that a tracked army could move at 100 miles the day, therefore such an army possesses twice the true mobility of aircraft.

My figures may not be accurate, but even if inaccurate, they alter the whole complexion of the present military problem. Should we now bank solely on our Air Force and leave the Army as it is? Or should we bank mainly on a mechanical army?

In the case of my Scottish-English war, had Scotland possessed a powerful mechanical army, it is conceivable that this force might have penetrated into the Midlands within three or four days of the opening of hostilities, and have denied the English air force its base, by keeping the English aerodromes in constant movement. Such action I consider perfectly feasible, not with our present tanks, but with tanks and tracked vehicles which can be constructed. If we are only thinking in terms of offensive action, it would be legitimate to conclude that the aeroplane is the handmaid of the tank. But we cannot, for we must also think protectively, because, in war, our aim is to secure the national will as well as to enforce it. To chase after panic-stricken aerodromes is not our object, it is only a means towards attaining it. It is one of our means, and the more tanks the enemy possesses, the more will these means be opposed. I consider, therefore, that any conclusion which leads to the handmaid theory, is a false conclusion. Fighting force is trinity in unity, it is not three forces, army, navy, and air force, but one force.

The mobility of aircraft has rendered modern armies obsolete, hence the divergence of opinion between soldiers and airmen. The tracked vehicle can rejuvenate the army, and when the army is rejuvenated, this divergence will disappear, and more and more would this be the case should the Air Force and the Army be directed by a combined General Staff acting under the direction of one man.

What then, shall we see? Not two strategies, but one strategy; not two tactics, but one tactic. We shall see one object and a moving objective; an objective we have got to halt before we are sure of hitting it. We shall see the commander-in-chief and his general staff replace the boxer. His two fists are his mechanised army and his air force. Sometimes the army will fix the enemy by holding him in front, whilst the air force will knock him out in rear; sometimes the air force will hold the enemy in rear, and the army will knock him out in front. Thus, I think, will battles be won, not because one Service does the dirty work of the other, but because both Services are in fact one force—a fighting force, and not a disputing force, a force based on the eternal principles of war, and not two forces obsessed by party opinions and separated by petty jealousies.

CHAPTER XVI.

THE INFLUENCE OF MECHANISED ARMS ON FIELD ENGINEERING.(1)

Having now considered a series of mobile problems, and having shown the importance of mobility in land and air operations, it is necessary to strike a balance. All tendencies to-day point to an increase in speed and radius of action; but this must not blind us to the importance of developing the opposite factors. Simultaneously with increasing power to move, must the problem of restricting movement be considered. The one is complementary to the other, for without a stable base of action from which movement can be initiated we shall possess an army which may be compared to a swordsman without a shield. This problem of resisting movement in order to increase our own mobility by restricting the enemy's is discussed in this chapter.

To-day the Army is entering a period of transition; the old military organisation of 1914 which we still possess in but slightly modified form, an organisation which did not prove itself adapted to mobile warfare, is now in the position of a defendant cross-examined by the mechanised arms. During the present year a radical change has taken place in the official doctrine; infantry are no longer the only arm which can win battles; further still, a Mechanised Force has been created, and though its object is still somewhat obscure, as it gains form I think it is likely to be the construction of a mould in which at some future date the older arms and formations will be re-cast.

Before the war, so now to-day, the aim of all tactical training is to produce mobility on the battlefield. In 1913 we thought of advances of

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(1) Lecture given at S.M.E., Chatham, November, 1927.

20 miles in a day, now many of us are thinking of five times this distance. Though the change is one of degree and not of idea, it should not be forgotten that during the Great War there was little mobility; it was a war of pick and shovel. To-day, there is nothing definite to assure us that this condition will not repeat itself, for past history shows us that periods of mobile tactics have normally been succeeded by periods of static warfare, battles and sieges following close upon each other's footsteps.

In illustration of what the future may have in store, I will turn back to the last great revolution in warfare, the introduction of fire arms, and then later on turn to the present revolution, the general adoption of petrol-driven machines, and see, whether from what lies behind us, we cannot in a limited degree foresee what lies before.

During the fifteenth century fire arms were not only in their infancy but strongly opposed. During the sixteenth century their crudeness and slowness of loading, in place of rendering movement more rapid, slowed it down. Formations were organised like fortresses, with flanking bastions of musketeers, and power of manœuvre was all but non-existent. Then came Maurice of Nassau and Gustavus Adolphus; they changed organisation, tactics and training, with the result that during the last half of the Thirty Years' War astonishing mobility on and off the battlefield was frequently developed. The direct result of this was a re-casting of fortifications culminating in the work of Vauban, the greatest engineer of his age, and this led to siege warfare. Who can say that, to-day, tactically we are not at the beginning of another Thirty Years' War period; the resemblances are marked, and who can say how long this period will last, and whether or not it will be followed by a Vauban period. Personally, I am of opinion that eventually this cycle, the cycle of the seventeenth century, will repeat itself, because tactical evolution is begotten of the pressure of Movement and the resistance of Protection, the link between these being Offensive Power.

Offensive Power may be either aggressive or resistant. In 1914 it was in the latter mood, for the killing power of the bullet was so high that normally the attack could be beaten back or checked by the defence. The result was siege warfare, and had this been realized before the war, in my opinion the best possible course of study would have been to return to Vauban—in fact, if air photographs of parts of the great "Hindenburg" zone of trenches are examined, the defence system they show might almost have been designed by him.

To-day, offensive power can definitely be rendered aggressive, and why? Because direct protection against bullets has been rendered mobile. For parapets, parados, traverses and dug-outs can be substituted bullet-proof armour which can be moved over the battlefield. Earth has been replaced by iron as the shield of the soldier; this is a detail, but what is a radical change is that muscle which could not move earth defences is being ousted by petrol which can move bullet-proof steel. Petrol must, therefore, be the pivot of all our thoughts.

Pressure and resistance go hand in hand, especially in human affairs, the one begetting the other. If I have an idea and you oppose it, the more I insist, the more you resist. The idea to-day is that because of petrol power tactics will become mobile, consequently, field warfare will predominate over siege warfare. Everything points to this idea being true as long as the opposite idea remains dormant. But it cannot be doubted that, if in war one side can resist enemy pressure without detracting from its own power to press, that side is going to win. In brief, if to-day we spend our time in thinking out mobility and neglect stability, we shall find in the next war that our mobility has no backbone. We shall be able to pursue, but we shall not be able to hold. A war based on such tactics may endure longer than the last one. This is another lesson the Thirty Years' War can teach us. Armies chasing each other's tails year in and year out, and never a decision because the art of holding, or fixing, an enemy has not been developed.

Holding requires ability to resist—to clinch, and also to resist being thrown. Holding is one of the duties of the field engineer. He builds a fortress to hold up an army, or a trench to hold up an attack. He blows up a bridge to hold; he inundates an area to hold; holding in one form or another is patent to him. Conversely, he understands how to overcome holding so that the mobility of his own side may be maintained.

Resistants may be divided into two categories—natural and artificial. In the first may be placed mountains, rivers, swamps, forests, deserts and buildings, for they are permanent obstacles. The second may be divided into three groups—protective, mobile, and offensive. Thus a fortress, or trench, or "pill-box," is purely a protective construction, it shields the soldier; a demolition, an inundation, or a gas-field, resists his mobility, whilst mine-fields may be considered as offensive resistants. All these means possessed certain values during the infantry period of war; these values will change during the mechanised period, and the side which more fully grasps these changes will be able in the highest degree to develop its own mobility, and to resist and so hold that of its enemy.

The Great War ought by rights to have been an engineers' war. From the autumn of 1914 until that of 1917, on the Western Front, it was purely a series of siege operations. In place of being a war run by professional engineers, it was a war run by amateur pioneers, and the result was a chaos of earthworks. In spite of this it remained static on land until the tank was introduced and used in numbers; this did not happen until the battle of Cambrai—November, 1917.

The influence of the tank on field engineering was prodigious. Wire as an obstacle lost its power, and so did trenches even 16 feet wide. Towards the end of the war, a tank was built, which, by means of a portable crib, could cross a trench 20 feet in span. It may be said without exaggeration that in the first hour of the battle of Cambrai an entire epoch of field engineering vanished in thin air. Those things which, since 1914, had constituted the most formidable obstacles, were now found to be no more than minor inconveniences. To those who could grasp it this revolution was dramatic in the extreme. At the third battle of Ypres we spent £22,000,000 in cutting wire entanglements, at Cambrai the cost was that of a few gallons of petrol.

At first the Germans looked upon the tank as a freak, then they attempted to resist it by gun fire, and though they had thousands of guns, no well-mounted tank attack ever failed. Only towards the end of the war did they begin to consider the problem from an engineering point of view, and their idea went back to the Martello tower.

This idea was perfectly sound, and will undoubtedly be developed in the future. At Mortella Bay, in Corsica, a single tower garrisoned by thirty-three men held at bay a British squadron of five ships. This was in 1794. To-day we can still see the children of this stronghold at Eastbourne, Hythe and elsewhere. The idea is sound because the tank is not a siege weapon. It is possible that, at some future date, tanks or tank-like machines, may be equipped with heavy howitzers and guns, but their number is almost certain to be small. The tank proper is a mobile warfare machine, its deadliest enemy is its like, consequently, its primary weapon is a small calibre, high velocity gun, a weapon which can penetrate tank armour, and not one which, like the 18-pounder, is suitable for anti-artillery and anti-infantry work, or one like a heavy howitzer which is suitable for the reduction of fortresses.

When this is realized it will be understood what a potent defence against tanks the tower will be. It may be of all kinds—stone, brick, wood or earth. There is nothing new in this, for the tower in one form or another has nearly always been used in war. In the South African war it took the form of a blockhouse, and in the last war, though permanent fortifications could with comparative ease be pounded to pieces by gun fire, towards its close it was found that concrete " pill-boxes " could withstand the most severe hammerings.

I will now turn from the past to the future. First, I will lay down in idea rather than in detail, the type of army which will be used in mobile warfare. It will be an army based on petrol, and though all its parts may not be able to move at similar speed, or cross similar natures of country, when unopposed it will be able to advance 100 miles a day. This means that it must be comparatively small, and that its organisation must be simple. It must, however, be able to find the enemy, to hold him when met with, and when held to hit him, and to pursue him; further, it must be able to protect itself, that is, resist the enemy, and according to the strength of this resistance so will its mobility be maintained.

I do not intend here to lay down a detailed organisation, in place I suggest that a number of small forces consisting of reconnaissance and holding machines will operate on an extended front, each group separated from the next by several miles. That whenever one group is seriously opposed, neighbouring groups will rush in on the opposer's flanks or rear. The tactics proposed may be compared to a series of pincers advancing with jaws open ever ready to close on an antagonist. Behind this chain of pincers, so I think, will come the main hitting and pursuing force, and behind this force the army of occupation —infantry, artillery, and cavalry, much as they are to-day.

Outside mechanical mobility, which for road work should be uniform throughout the force, but not necessarily so across country, movement is governed by internal and external factors. The first are training, organisation, command, intercommunication and staff work, and the second information, the nature of the country, and enemy action. Mobility will be seriously impeded until the enemy is found; for until contact takes place the commander of a highly mobile force will be apt to be nervous, actions will take place more rapidly than heretofore, and mistakes will be paid for more dearly, since there will be less time wherein to rectify them. Moving swiftly, mechanised forces will be more influenced by the nature of the country than the armies we know to-day. Their flanks and rear will be more open to attack, and their communications, though more elastic, because of their power to move across country, will, nevertheless, be even more vital than in the past, since if their petrol supply is cut off they will be brought to a standstill.

The finding of an enemy will largely depend on air reconnaissance, and air power depends on landing facilities, consequently, landing grounds will have rapidly to be made and protected. Without air superiority, surprise will be gravely restricted, and surprise in mechanical warfare is obviously all important. A country which is favourable to cross-country movement is generally favourable to air observation; therefore, in such a country there must be a very close alliance between tanks and air power. As the latter increases in size and efficiency it will become increasingly difficult to manœuvre large mechanised columns over open country if secrecy is to be maintained, consequently night movements are likely to become frequent. The danger of moving large forces will undoubtedly be met by advancing in small columns as I have suggested, for one of the characteristics of a mechanised force is its power of dispersion without great loss of tactical strength. The aerial answer to dispersion is concentration. Bombing attacks must be concentrated on a few localities, namely, those which are vital to cross-country movement, such as defiles, bridges, and petrol supply centres.

Once the enemy is found he must he held or delayed, either to prevent him getting away, or to prevent him getting on. For such work maps should show areas suitable and unsuitable for cross-country movement. In the past the marking down of geographical features has been sufficient, but in the future tank obstacles must also be shown. On retiring troops, these will undoubtedly exercise as magnetic an influence as fortresses have done in the past, consequently, their nature must be known, and their lines of approach clearly marked. Besides natural obstacles, such as rivers, mountains and forests, many local ones will be met with, for example: a broken bridge, a mine field, a stockade, a tower, an inundation, and many of these will have to be dealt with both in the making and unmaking by field engineers.

Two of the most important types of obstacles which are likely to be used are demolitions and gas inundations. Strategical demolitions should be concentrated at a few vital points and not dispersed; they should particularly aim at hindering the enemy's system of supply, and should shepherd the enemy into desired avenues of approach. Persistent gas is a strategical weapon of the highest importance; it will demand most careful control, and I consider that its most effective use is in concentrated bombardments against vital points well in rear of the enemy. In a friendly country, however, its use is likely to be restricted until the civil population is evacuated, and this alone accentuates the importance of carrying the war into the enemy's country.

Thus far I have examined this problem in a general way. I will now take a concrete case. I will suppose that a German mechanised force invades Belgium through the Liége gap, and then consider how this force can be delayed.

The front of this invading army is virtually restricted to Visé-Liége, or a little south of this town, and between these two flows the river Meuse, a formidable obstacle commanded by a ridge of high ground on its western bank. The area east of Liége is densely populated and much built over, consequently movement will be almost entirely by road. The invader wants clear roads, intact bridges and freedom from air interference until he is clear of this defile. His rail communications concentrate at two definite points, Aix-la-Chapelle and Malmédy.

The object of the Belgians would almost certainly be, not to defeat the enemy, but to delay him until they are supported by France or ourselves. They might bomb Aix-la-Chapelle, but it is unlikely that they would bomb Malmédy or any other town in their own territory, especially at the opening of hostilities. They could prepare during peace time the whole of the country east of Liége for demolition and gas inundation, but would they? Even if they did, the attack is likely to be so rapid, that unless they demolished the country before it takes place, which is unthinkable, they will never find the time wherein to do it.

It will be seen from this brief survey that though to-day we possess several new means of resisting an enemy, political and social factors are likely to hinder us rapidly putting them into force in our own country. We must, therefore, fall back on less drastic means of resistance, means which will delay an enemy without seriously affecting the civil population or destroying the country.

Until mechanised forces become amphibious, rivers will, so I think, play a leading part in delaying them, and even more so than in the case of non-mechanised ones. In the protection of the Liége gap, the Meuse is still the axis of defence. In 1914, comparatively speaking, the Liége forts were easily reduced, and in another war such large constructions would become easy targets for mustard gas bombardment. As in former days Liége itself was a fortress, and then became the centre of a circle of fortresses, so in the future such vital points must become the centre of a fortified area of a great extent. The reason is obvious: The ever-increasing range of gun fire has compelled walled cities to be replaced by entrenched, or fortified, camps, so also in the future will the new factor of cross-country movement force the defender to replace these by a large number of small anti-tank and gas-proof works, works which will protect an entire area. In the present case nothing short of a complete protection of the Liége gap can guarantee the closing of this front door into Belgium.

Area defence, in contradistinction to positional, or local, defence, is now one of the problems which face the engineer. Such defence must be in depth as well as breadth. Fortifications are likely to be numerous and small, and they must be shell-proof and gas-proof. Zones of modernised Martello towers suggest themselves. Towers sunk in anti-tank moats and possibly encircled and connected by mine-fields. The top of the tower, I imagine, will only just appear above the level of the ground, crowned by a small revolving steel cupola containing one anti-tank gun, its garrison numbering about ten men.

I do not suggest that these towers should be sited in a regular pattern, but that they should be located at all tactical points of importance, points where the enemy's mobility can be halted. They should, when possible, be mutually supporting, and be provided with some hidden means of exit which will allow their garrisons retiring should their gun be put out of action.

In this lecture I have said little about engineering, as engineering, and on purpose, because before the future of the field engineer can in any way be determined, it is essential that a fairly complete picture of the conditions in which he will be called upon to work in be sketched out. I will now summarise those I have touched upon.

Throughout history, increase in tactical mobility has always begotten increase in protection, and as mobility has changed, so has protection followed suit. This being so, we may predict that the present nature of field engineering will not only change, but as mobility increases, field engineering will grow in importance.

To-day petrol is the governing tactical factor in war, its main influence on armies is that it extends their "locomobility," that is, their area of action. As movement becomes more and more universal over the surface of the earth, so must protection become more all-embracing. Formerly line met line, and the line protected its rear, but in the future lines will give way to areas, and consequently areas will have to be defended.

The ponderous earth-armour of 1914-1918 is rapidly being atomised and replaced by mobile steel plates. The result is that the problem of how to resist them, that is, restrict their mobility and hold them, is one which must be considered if tactics is to remain an art. The field engineer is by nature a holder, and before he can decide on how he should hold, and with what he should do so, he must study the weapon-power of mechanised armies.

The principle weapon is the small calibre high velocity gun, and the power of this weapon will give us an idea of the nature of the defences and fortifications we shall require in order to resist it. The tactics of mechanised forces suggest a series of small columns followed by more powerful ones, or of a series of pincers followed by a hammer. The power of such an army largely depends on air reconnaissance, and the security of its line, or lines, of communication, and its area of supply; consequently, the field engineer will have to concern himself deeply with the protection of communications and the making and defence of landing grounds.

As communications grow in importance, their key positions, defiles and bridges, will become more and more objectives of attack, and consequently will have to be more powerfully and adequately defended. If bridges are destroyed they will have to be rapidly repaired. Again, the army which can bridge the more rapidly will vastly economise its time, and increase its radius of action.

A host of old, new and modified means of defence suggest themselves, of which the most important are gas inundations, land mines, stockades, towers and demolitions, all of which are the work of the engineer. When contemplating their use, he must free himself from past theories of war, and must remember that whilst up to the present tactics and strategy have in nature been mainly linear, that is, horizontal lines for fighting, and vertical lines for moving, they are beginning to change, for the square is replacing the line. Field fortifications must follow suit. In another great war, a line of defences, flank to flank, will be next to useless, for field defences will have to be in depth, a depth which can only be measured by the degree of mobility possessed by the enemy. If the enemy can advance 10 miles in a day, depth is of one degree; but if he can move 100, it must be of another. It is by watching the progress of petrol-power whereby the engineer will be enabled to read his future.

To-day this future is vague; it is seen like a mountain through a mist, its contour alone is dimly outlined. We cannot for certain tell whether it is of rock, shale or earth. All we know is that it is there, and that the mist will not endure for ever. It is for this reason that I have not attempted to enter upon detail. All I have done is to point out to you what the mountain looks like, at least to me. One day you will have to climb it, perhaps before the mist clears away, therefore you should be prepared to do so, and in my mind your best preparation is to watch and follow the progress of the mechanised arms, and to modify your tactics, organisation and training accordingly. Finally, do not forget that history has a curious knack of repeating itself—mobile warfare will not endure for ever, and the length of its duration will largely be the measurement of our ignorance in field engineering.

CHAPTER XVII.

THE IDEAL ARMY OF THE ARTILLERY CYCLE.(1)

Having, in the preceding chapters, examined a number of new problems, the object of this concluding one is to sketch out a key-plan to work to. By itself experimental work is not sufficient. All experiments, either in weapons or organisation, should be directed by one pivotal idea. Such direction is impossible without a goal. In this chapter an entirely new army organisation is worked out in embryo, not that it is considered that this is the shape the army will assume twenty years hence, but that unless we establish, on as sound a foundation as possible, a hypothetical organisation to direct our thoughts and work, these will be largely squandered and wasted.

Introduction.

It is a fact beyond dispute that military organisation underwent marked changes during the war, and that the armies of 1918 were very different from the armies of 1914. Had the war continued to 1922, the armies of that date would have been still more different; and had it continued to 1926, we may well infer that those of 1926 would have been so different from those of 1914 that the relationship between them would be scarcely recognisable.

To-day, military organisation still closely resembles that of 1914, consequently, if we bear the above evolution in mind, we may conclude that there is room for improvement. During the war, Necessity, as always, was the mother of invention, demand created supply, and evolution, however haphazard, was rapid, for war is a struggle for existence in which comparatively only the fittest organisations survive. In peace time there is no necessity, there is no tactical struggle, consequently, unless evolution is to be excessively slow, we must replace Necessity by Hypothesis, and tactical struggle by logical thinking. We must become rational visionaries.

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(1) *The Journal of the Royal Artillery,* October, 1926.

Since the war much experimental work has been carried out in the greater armies. A number of weapons of war, each embodying an idea, has been produced, but, as far as I am aware, no attempt has been made to co-ordinate these ideas by establishing a common goal towards which all should converge. What at present is lacking is a key-plan to work to, and without such a plan it may one day be found that it is impossible to organise the inventions introduced during peace time, that is, to fit the parts together so that they will produce one co-operative whole.

It is my intention in this paper to outline such a plan, if only in embryo, a plan which though it can be no more than an ideal, is sufficiently well-founded tactically and organically to permit of it being applied to the more general conditions which will confront an army in a great war. To examine the special and particular conditions which face individual nations is outside the question, yet it must be remembered that, before the ideal can be transformed into the real, these conditions will have to be examined and weighed out.

As in all countries money is insufficient to allow of the constant change which Necessity forces on us during war-time, I have no option but to look well ahead. It is useless laying down what an army should be like in 1930, for when the year 1930 arrives it will have to be changed to what it should be like in 1935, and then later on to 1940, 1945, and so on. We must not, however, look too far ahead, therefore, I will fix my model at the year 1946. This permits of 20 years to work in, and though it is not possible to see *in detail* what an army of 1946 will, or should, look like, failing some unknown and revolutionary scientific discovery, it is possible to base the ideal model on sound tactical principles, and to do so we must examine very carefully a whole host of changes.

I. Changes in Conditions.

1. *The Lessons of the Great War.*

All wars are problems of movement, which is tactically gained by protected offensive action. The last great war offers no exception to this rule, for in spite of its static nature it was a prolonged struggle to establish mobility. Movement was its predominating problem, yet, in spite of this, all nations are to-day less well prepared for a war of movement than they were in 1914, since military organisation has not radically changed, and yet has become more complex. The

1914 organisation led to static warfare, since fire-power was more than human nature could endure. To-day, small arm fire is, generally speaking, three times as great as it was in 1914, yet protective power is about the same, since artillery power has changed but little,[1] and tank power is insignificant. Consequently, whatever may be the doctrines laid down in the training manuals, the main tactical problem in a great war remains static warfare.

Since 1914 fire-power has increased, and protective-power, which should be the base of fire-power, has remained much as it was, consequently, tactical mobility is actually less than it was in 1914. The reason for this short-sightedness is that the supreme factor which differentiated the last war from all preceding wars, namely, the petrol engine, has been overlooked. It was not increase in fire-power which enabled the Allied Armies to move forward in 1918, but the increased protective-power rendered possible through the high horse-power of the petrol engine. Once half an inch of steel could be carried before the soldier, his fire-power was multiplied many thousands of times, because this half inch of steel reduced the enemy's small arm fire almost to zero. The supreme military mistake of 1919 (one made after each great war in history) was that nations were so blind to the most important lesson of the war—

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[1] Though great improvements have been made in gun construction since 1918, the number of guns in all great armies has been drastically cut down.

protected mobility—that in place of reorganising their armies according to this lesson they returned to their pre-war organisations.

In the past, military organisation has evolved on the costly system of trial and error, coupled with the omission to disband certain war-raised units, and tempered by imitating foreign innovations. It has been a grossly inefficient system, and extravagantly expensive. In our own history, however, two remarkable exceptions to this blind process of development are to be found, namely, Cromwell's "New Model" and Moore's "Light Brigade." The second had a stupendous influence on our army, and was the most important tactical factor in undermining the power of Napoleon. Once Moore's system was generally established, the British for five years never suffered defeat.

Moore's system was rational and not blind. It was based on *observed* trial and error, that is, on experiment, the aim of which was to explore and develop *a definite idea.* His idea was that of an organisation which could move rapidly and which in movement would be better protected than that of any Continental Power. He built a machine to carry out an idea, and not the parts of a machine from which ideas might or might not be developed. Without this idea his work would have been blind.

2. *Changes in Strategical Conditions.*

Before reconstruction can be directed along economical lines, the idea which should control the work must first be determined. This is not a difficult problem to solve, since a study of history will show that this idea has never radically changed; it is the idea grasped by Moore, or for aught that by Alexander; it is rapid and secure movement in whatever direction is determined on. If an army can move twice as fast as its adversary, and is so strongly protected that it loses but one man to his two, then it will have twice as much time at its disposal, and, in comparison to its enemy's strength, its own will be double its muster rôle. *Secure movement* should consequently be the tactical pole-star of the military organiser.

Though this idea is fundamental to the maintenance of economy of force, its development into a concrete organisation is dependent on the conditions which surround us. Hitherto strategy and tactics have been in nature linear. Armies have marched by road or have been conveyed by rail, and line has met line on the battlefield. To turn a line, or to attack a line in rear, has always been a difficult operation. In early days it was possible to do this with cavalry; in recent times only by overlapping, or by the advance of a separate army, consequently, large numbers of men were required. The result has been that most attacks have been frontal, and as fire-power has increased these attacks have become so costly, that to-day the infantry assault is almost as rare as the cavalry charge. Concurrently with this increase in fire-power we find army organisation growing more and more complex, not only tactically, but administratively. So much so has this become the case, that fear of exposing the rear services to destruction, not so much through enemy action *as through change of position laterally,* has restricted manœuvre, and has compelled armies to move forward with their fronts at right angles to their communications in order to secure them, and in order to avoid any lateral change in their positions. As manœuvre has been restricted, and as the assault has lost its power, frontal attacks have grown into prolonged operations of attrition in which leadership and command have been replaced by moral endurance and material supply. In the last great war, as long as the enemy's front remained intact, generally speaking, his rear remained secure.

To-day this condition no longer holds good, for aircraft can fly over existing armies and attack them in rear; tanks can break their front, and armoured cars can rapidly envelop their flanks and attack their rear services—their stomach. We know that these operations are possible, since during the last year of the war they were carried out with astonishing success. The rear attack has now become a feasible operation, and will, in my opinion, become the governing tactical operation in war. What does this mean? It means that in the future, battles will not be fought in more or less rigid lines, but over areas. Fronts may be anywhere, flanks may be anywhere, as at sea, but the rear will remain that point which is closest to the main base of supply—again as in naval warfare. Armies must consequently be organised to attack or protect this point, not by forming a front at right angles to the communications leading to it, for all fronts will be hypothetical until contact takes place, but by possessing "locomobility," that is, power to move and to secure movement in any direction over a given area.

Our present idea of mobility must be advanced in degree to cover not only an expanding and contracting area, but also a moving cube, since aircraft can move in three dimensions. At any point in this area, or in this cube, we must possess the power of concentrating superiority of force. It is not so much numbers which will enable us to do this as movement. If an army can move three times as fast as its enemy, then, other things being equal, 20,000 men will defeat 60,000, possibly 160,000. This is the reason why Alexander always defeated the Persians, even when they out-numbered him by twenty to one. His secret was secure mobility, and secure mobility is the mainspring of concentration of force.

3. *Changes in Administrative Conditions.*

The change over from linear to area strategy will demand radical changes in tactics, and, consequently, in organisation. Organisation is threefold: it is tactical, administrative and managerial. Tactical strength depends on fighting power which is based on freedom to supply the combatant portion of the army. The first problem is, therefore, an administrative one, including bases of supply and lines of communication. There are three main categories of bases, namely, main bases (which in our wars are generally coastal); advanced bases, such as rail-heads; and mobile receiving depôts, or field bases, which are in the immediate rear of the fighting troops. In linear warfare the problem is comparatively a simple one; the army moves forward and deploys, and its deployment protects its rear organisation by offering to the enemy a front which must be attacked or circumvented, the last mentioned operation being, as I have shown, an exceedingly difficult one in this type of warfare. In area warfare, comparatively speaking, it is easy, and unless the rear organisation of an army is self-protective and mobile, it will offer a tempting objective to an enterprising foe. The rear attack is, therefore, likely to become *a normal operation of war*, and if it succeeds an army may be exterminated before it is able to fire a shot.

The rear attack will and must radically modify our present-day conception of field administration. Main bases[1] must as heretofore remain static, they cannot be moved, since factories and harbour accommodation cannot be shifted; they can only be abandoned. In area warfare, as a deployed army can no longer guarantee the protection of its advanced base, or bases, these must be self-protective, and as a battle may be fought at any point in the area of war, they must be sufficiently mobile to permit of their positions being shifted so that the freedom of movement of the field army is not restricted. In linear warfare armies have frequently manœuvred in order to protect their bases, in area warfare this operation will be reversed, and the side which can reverse it more fully will possess a tremendous advantage over its antagonist. Whilst main bases must become fixed fortresses, advanced bases must become mobile fortresses. In this last conception there is nothing new, for it is but a return to the mediæval laager which was normally drawn up behind the battle array. As in the case of the laager these advanced bases must not only be able to supply the fighting forces, but must offer them shelter when they require to refit—in fact they may be compared to land "floating docks."

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[1] Main bases may be divided into two categories:—
(*a*) Coastal bases such as the port of Havre during the war;
(*b*) Industrial centres, such as the Ruhr or the Bruay coal-fields.

The supply of these mobile fortresses may be by road, rail, or across country. The lines of communication leading to them may be attacked from any direction, especially if they are static—roads or railways—consequently, their supply must be carried out by protected convoys working from the fixed main base. Should the distance between the main base and the advanced base become too great, intermediary fixed bases, or defended depôts, must be established, these forming temporary "land-ports."

The administrative problem is no longer one of peaceful movement behind a protective screen —the field army—for in area warfare administration and tactics are more closely interknit. The administrative troops must not only be able to supply the field army, but protect themselves against air attack and mechanical raids; they must become more and more fighting troops, so that the combatant portion of the army may possess freedom of manœuvre.

4. *Changes in Tactical Conditions.*

The administrative services having been so organised that freedom of manœuvre is possible, the next problem to solve is one of tactics. It is not a new problem, it is an old one in changed form. The enemy must be found; his power to move must be restricted, and finally, his power to fight must be destroyed. Thus we get three definite tactical acts—finding, fixing and destroying. To find an enemy demands reconnaissance, and as in area warfare he will not be so intimately tied to fixed lines of communication, this duty will become a more complex one. To fix him, that is, to restrict his movement, as heretofore, will demand either clinching with him, or threatening his base of supply, or his lines of communication. Clinching will be much as it has been, but, if the enemy's administrative organisation is mobile, threatening will become more complex; also if his advanced base is threatened, or even besieged, it will frequently be possible for him to improvise or establish another, and so retain his initiative.

In the third act, namely, that of destruction, we find a remarkable change. The old method, in nine battles out of ten, resulted in a frontal attack, yet it was clearly recognised that flank attacks were more decisive, and rear attacks more decisive still. The new method will avoid the frontal attack, and will aim at a flank attack supplemented by a rear attack, or when feasible by a rear attack only. Surprise, and not numbers, will once again become the predominant factor. The destroying force must consequently be extremely mobile, and its mobility will depend quite as much on its power to fix the enemy as on its speed. Further, as it must depend for its maintenance on its advanced base, this must be equally mobile, or as mobile as possible. Superiority of mobility and not mass of numbers is the supreme tactical problem of area warfare.

The problem of management, that is, command and inter-communication, I will not examine here, for since the general adoption of wireless telegraphy and telephony, area inter-communication has been established. It is no longer necessary to know where a recipient is, for wherever he is he can be communicated with. In management, few radical changes are likely to arise.

5. *Changes in Tactical Means.*

From the above we see that in area warfare, as in linear, we get three essential forces, forces which can discover the enemy, forces which can detain him, and forces which can destroy him. In former days, these forces were represented by light infantry, infantry and cavalry, each, and more particularly the second, being supported by artillery. The tactical base of light infantry action was the ground itself, for their security mainly lay in skilful use of ground, and in presenting but a small target to the enemy. The tactical base of infantry was artillery, and of cavalry—the infantry and artillery action; the main power of cavalry resting on their mobility, which enabled them to take advantage of opportunities created by the infantry and artillery battle.

In recent years cavalry as the arm of destruction has become almost useless, light infantry has vanished altogether, and battles have become infantry and artillery duels in which superiority of numbers more so than any other factor has become the deciding force. Armies are defeated, but they are seldom destroyed unless they lock themselves up in fortresses, when destruction of fighting force is attained through surrender. In fact we see during the last hundred years, in spite of the stupendous improvement in weapons, a steady decline in the art of war, until in the Great War it disappears—there is no art, there is only brute force.

To-day, the main problem in tactical organisation is to re-establish the essential three-fold order of fighting, and the petrol engine enables this to be done, for its power permits of the carriage of armour, and so cancels out the bullet, which in recent years has been the chief impediment to movement.

We start with light infantry, infantry and cavalry as the three essential arms protected by artillery which is common to all three. Therefore, if these are to be placed on a petrol footing, scout machines, assault machines and pursuit machines will be required, each if necessary protected by an artillery machine. I will examine these four categories in turn.

The scout machine should be as small as possible and as fast as possible, which are not altogether compatible qualities. The assault machine should be heavily armoured; without considerable sacrifice of speed it cannot be made proof against armour-piercing shell, but it should carry armour of sufficient thickness to protect it at moderately close ranges from such heavy automatic fire as may be developed from the enemy's scout machines. In my opinion, as time goes on, this machine will in nature approximate more and more to the present conception of the artillery machine, until the two may quite possibly coincide. If this takes place, then I think that the present conception of artillery protecting the assault arm (to-day infantry) will be replaced by the older conception of the scout machines protecting the artillery machines which have replaced the assault machines, just as years ago light infantry protected the heavy infantry of the line. This will probably lead to two types of scout machines, namely, the scout machine proper which is used to reconnoitre, and the destroyer machine, which is used to protect the artillery assault machines from close attack, much as destroyers protect battleships at sea.

Until such time as the assault machine and the artillery machine coincide, which I believe they will do, there is little place in a battle between machines for any but light high velocity guns; the artillery machine must be able to destroy the assault machine and to cover its advance.

The pursuit machine should be the fastest machine of all; it should be lightly armoured, should possess a long radius of action, and be self-supplying for several days.

From the three tactical essentials of hitting, guarding, and moving may thus be developed three categories of machines, each of one or two classes, namely:

(i) (*a*) The scout machine, the duty of which is to reconnoitre (light cavalry).
  (*b*) The destroyer machine, the duty of which is to protect the assault machines (light infantry).
(ii) (*a*) The assault machine, the duty of which is to disrupt the enemy's organisation (infantry).
  (*b*) The artillery machine, the duty of which is to protect the assault machine until such time as this machine can develop its own protection (artillery).
(iii) (*a*) The pursuit machine, the duty of which is to follow up victory by exploitation (cavalry).

(*b*) The chemical warfare and bridging pursuit machine, the duty of which is to restrict or facilitate movement, in the first case by vesicant and other gas inundations; in the second by bridging (engineers).

Having now considered tactical changes related to means of movement and protective power, for all these machines will be armoured, I will briefly consider weapon-power, and here we are confronted by a very interesting problem. Before the outbreak of the Great War three categories of weapons were to be found in all civilised armies, namely, assault weapons (bayonet, lance and sword), in-fighting weapons (rifles and machine-guns), and out-fighting weapons (all manner of artillery). During the war a fourth weapon, gas, was added to these. Of all weapons the last one is likely to become the most potent against a muscularly moved army, but against a mechanical army is it largely impotent, as the man is shielded against vesicant gases, and, if necessary, a machine such as a tank can be rendered gas-proof. It is for this reason that I do not think that gas will prove a useful weapon against a mechanical target, but dropped from air-craft against non-mechanical targets its effectiveness can scarcely be exaggerated. As regards the *arme blanche,* obviously the bayonet, sword and lance can play no part in the tank battle, and it is equally obvious that the rifle and small-bore machine-gun can only play a minor part. We are left, therefore, with artillery *as the principal arm of the future.*

It is curious how history is apt to repeat itself. The general introduction of armour in the fifth century A.D. resulted in infantry playing a very minor rôle in battle for a thousand years. The reintroduction of armour in the near future, will, so I think, lead to a similar result, and as gunpowder introduced the great infantry epoch of war, a period extending from about the middle of the fifteenth century to to-day, so will petrol introduce the great artillery epoch. The superior weapon of the future *is the gun,* the superior soldier *is the gunner*, and the superior army *is a force based on mechanically-propelled artillery.* To-day we stand on the threshold of this third great tactical cycle—the artillery cycle.

If this deduction is a logical one, the next question which confronts us is: What types of cannon will be required in a mechanical army? To-day existing weapons are fitted into newly conceived machines. These weapons were built for a definite purpose, namely, a muscularly moved army, therefore, *a priori* we may consider them defective. In the past the main tendencies of gun evolution have been towards greater range, greater weight of shell, and greater accuracy and rate of fire. But in the mechanical battles of the future, range will mainly be limited to visibility of target, consequently, direct and not indirect laying will be the order of the day. Weight of shell will be limited by the armour piercing effect required, and not by fragmentation and strength of explosion. Accuracy and volume of fire will be all-important.

I do not suggest that long-range and high-calibre artillery will entirely disappear, but I do consider that long-range guns and heavy howitzers will play a very secondary rôle, far more so than to-day. What I do suggest is that in the future guns will definitely be made for tanks and similar weapons, and will be designed to destroy these machines and not primarily to destroy infantry. The future gun is likely to be of comparatively small calibre, and of high velocity and accuracy of fire. In my opinion, two main types are likely to be evolved, a cannon superior to but of the nature of the existing 3 and 6-pounders, and a heavy machine-gun firing a half to a one-inch bullet. The first will constitute the out-fighting, and the second the in-fighting weapon of the ideal army.

6. *The Constant Factors.*

Thus far I have examined what I believe to be the more important changes which are to-day influencing military organisation, and will, in my opinion, radically change it. This must not blind us, however, to the fact that certain factors remain constant, and are likely to remain so. Of these factors the two most important are human nature and ground. The first seldom manifests in its full form except in war, and is consequently overlooked during peace time; the second is more generally recognised, but its relationship to the means of movement we employ, and the possible tactics resulting are overlooked.

Before the last great war most soldiers were always talking of moral qualities until they had suggested to themselves that battles could be won by *moral* alone. Thus hallucinated, they stepped on to the battlefields of 1914 only to discover that even the best trained troops in Europe would seldom face modern rifle and machine fire more than once. Human nature could not stand the fire-power of 1914, and the result was static warfare. To-day, small arm fire-power has been multiplied three times, yet military organisation is no more self-protective than it was in 1914. To insist that European or other armies are to-day preparing for a war of movement is, in my opinion, incorrect, they are doing nothing of the sort. What they are preparing for, however unconsciously it may be, is to be surprised by the machine-gun as they were surprised twelve years ago. They are preparing for a war of slaughter, not for a war of movement, and no nation during the next thirty years is likely to tolerate the shambles of 1914, 1915, 1916 and 1917.

Intimately connected with the moral factor is the factor of ground. Ground is a constant condition, or at least one which changes very slowly. The means of moving over it have in the last hundred years radically changed, and these means may roughly be divided into mechanical and non-mechanical categories, consequently, ground also should be divided into two categories, ground over which cross-country machines can move freely, and ground which is unsuitable to them. For brevity I will call the first " tank areas," and the second " infantry areas."

It is obvious that armies must be prepared to fight over both these areas,[1] and it is also obvious that unless infantry can move at the same pace as tanks, unity of control and action will be most difficult and frequently impossible, unless the speed of the tank forces is restricted. It stands to reason, therefore, that to maintain the maximum mobility, such infantry as are required to co-operate with the mechanical forces must be mechanised, that is to say, when not fighting, they must be carried in cross-country machines. In tank areas infantry are an incumbrance, and in infantry areas tanks are equally so, and as the nature of the ground fought over cannot be changed, consequently, organisation must be adapted to fit it. For example: if a General is confronted by a battle in a tank area, one thing he does not want to do is to detach a tank force to protect his infantry units. The infantry must be so organised and equipped that they are self-protective against tanks, they must, in fact, be able to form an anti-tank laager. We must thus get back to the question of the field base, which should be organised as a mobile fortress, and which should form part of each fighting formation. It should also be organised in two echelons (*a*) and (*b*), so that one may remain loaded up whilst the other is away replenishing its supplies. We see, therefore, that these field bases fulfil two purposes, not only do they supply their formation, but they constitute also havens of refuge for either tanks and infantry when not in use, as well as defended harbours for the assembly of such transport as is not required in the battle itself.

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[1] As the infantry areas will normally cover mountainous country or forest land, present ideas on infantry training and tactics will have to be modified. A skilful light infantry will be required in the future, and not the " heavy " infantry we know to-day.

From the above the following requirements are arrived at:

(i) Three main categories of tanks, each in one or two classes.
(ii) The infantry required to accompany a mechanical army must be carried in cross-country vehicles.
(iii) Each main formation must be organised to include a protective mobile field base (in two echelons).

II. CHANGES IN ORGANISATION.

7. *General Tactical Organisation.*

Having considered the question of means, I will now turn to the problem of tactical organisation, and see how these means can be set together in a co-operative order.

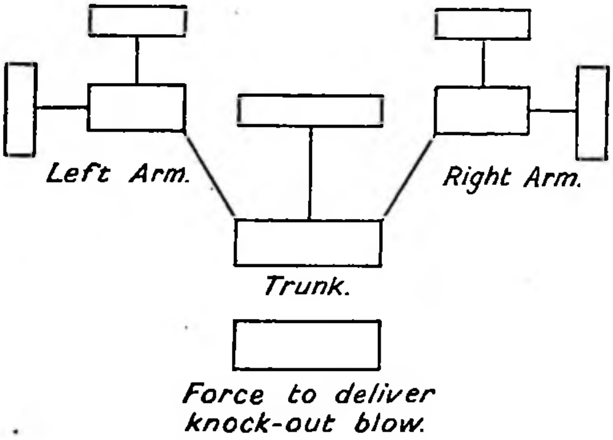
An organisation must possess not only offensive-power, but protective-power, and these two essentials must be so ordered and related that the mobility of the organisation is in no way impaired.

Security demands not only tactical liberty, which is gained through protected offensive action, but uninterrupted and adequate supply. Hitherto the second of these two requirements has generally acted as a brake on the first, but if the supply services can be rendered self-protective, and can be organised to move as rapidly as the combatant troops, then this difficulty will be largely overcome.

I have already examined the question of bases and of advanced bases, and I have also suggested that each main formation such as a division should include a mobile self-protective field base. The possibility of supplying these field bases from the mobile advanced base, and of securely convoying supplies from the main base to the advanced base, and from this base to the field bases will constitute the administrative order from which offensive action will spring. Without this order strategical and tactical stability will be wanting. Hitherto this order has been tied down to roads and railways; in the future, though these means of communication will continue to play an important part, their limitations will be considerably modified by power to move across country, until possibly cross-country movement will become the most important factor in supply.

Turning now to offensive action, which will depend for its freedom on the integrity not only of road and railway communications, but on secure movement over entire areas, the tactical requirements are those I have already enumerated, namely, the enemy must be discovered, his movement must be restricted, and finally he must be smashed. These three operations must spring from a protective organisation which by resisting the enemy's pressure can gain freedom of movement for the troops carrying out these three tactical requirements. By power to resist pressure I do not mean only ability to deal blows, but a strength so ordered that the enemy will either refuse attack, or spend much time in manœuvring before attacking.

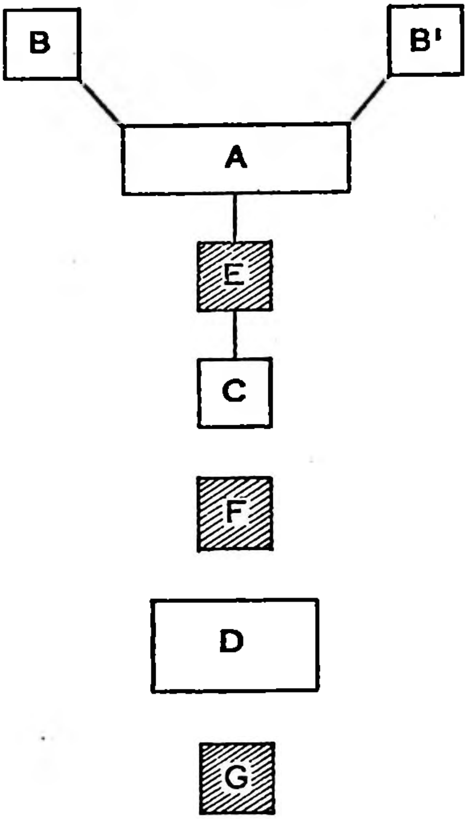
The stable base of operations, that is, the protective order from which offensive action is developed, I will call the trunk of the army. To hold an enemy requires at least two tactical arms. These arms should operate from this trunk which should be in close touch with the administrative field base, so that any large hostile force attempting to attack this base will be met by the full resistance of the trunk. To discover the enemy requires a reconnaissance force, which obviously must work in the closest co-operation with the trunk and the two arms, and consequently, should form part of these organisations. To smash the enemy requires a separate highly mobile force which, when the enemy is held, will strike him in flank or rear. If, however, tactical, or geographical, conditions prohibit this force manœuvring, then the trunk, protected by its arms must push its way through the enemy and so create an avenue of approach leading towards the enemy's rear services—his vitals. Diagrammatically, the tactical organisation suggested may be shown as follows:



In idea this organisation is a return to the order of battle evolved by Philip of Macedon and Alexander the Great, but possessing more flexibility and endurance for prolonged fighting, as the force which is to deliver the knock-out blow is held in reserve. In the Roman army, which seldom made extensive use of cavalry, the trunk is immensely strong, and is the main instrument of pressure as well as of resistance. In mediæval armies the trunk dwindles into significance, and the arms unite and become purely armoured cavalry. In the days of Napoleon a return is made to the classical period, and the French army organisation is largely based on the Roman model tempered by extensive use of cavalry to deliver the knock-out blow. Since his day, light and heavy infantry have merged into one arm, and cavalry power has become more and more limited until it has all but disappeared. The influences of these changes on tactical organisation have been radical; armies have lost their mobility and flexibility. The trunk has grown more and more resistant, and less and less able to press an enemy back. The arms have disappeared, and a return has been made to the rigid linear system of the seventeenth century. Light infantry are replaced by cavalry, and infantry are strongly supported by artillery. In fact, in 1914 it was not infantry who prepared the way for cavalry, but artillery which prepared the way for infantry, in order to render the infantry assault possible. The assault had, in fact, replaced the cavalry charge. Then, as the war developed, it was discovered that the assault in its turn had become almost as limited as the charge. It is to this purely linear organisation, namely, a line of guns and a line of riflemen that all armies returned immediately after the war, an organisation as primitive as that of a line of spearmen and a line of bowmen. I have made this digression because it is important to realize how defective existing military organisations are.

As the destruction of the enemy's strength is the aim of battle, so also is the occupation of the enemy's country the aim of war, so that a condition of non-resistance may be established which will permit of political action taking effect. As the occupation of a country is mainly police duty, numbers of men rather than strength of fighting power are required. These men should be organised into a separate force, for if they are added to the field army they will seriously detract from its mobility. Their use is after the battle, not during it; in fact, on the battlefield they can only prove a serious encumbrance.

I will now chart out the whole of this ideal organisation diagrammatically:



A is the trunk of the field army, and B, B¹ are its two tactical arms, all three possessing their own reconnaissance services. On the outbreak of war, B and B¹ move rapidly forward and search for the enemy, or occupy positions which are of importance to him. Once they discover him, they restrict his movements in order to gain time for A to clinch with him. Once A obtains a firm hold, C moves forward and attacks the enemy in flank or rear; or if the enemy is already broken, pursues. If B and B^1 are driven back, A protects them, and, if necessary, C counter-attacks. Once the enemy's field army is destroyed, D occupies the conquered country. So much for the tactics of this organisation, now as to its supply services.

E is what I have called the field base, or formation laager,[1] it supplies A, B, B^1 and C, and is protected against any operation other than a raid by the close proximity of these forces. It is supplied from the advanced base F which is a mobile fortress; supplies being convoyed from F to E. F is similarly supplied from the main base G, which is a static fortress. D can find security in G until required. Such, in brief, I believe, is the organisation suitable for area warfare. I will now in some detail examine each part of this organisation.

8. *The Organisation of Supply.*

Accepting the above organisation as a hypothetical model, I will first examine its system of supply, for on it depends to a large extent the freedom of movement of the field army.

To start with the main base—G on the diagram.

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[1] For simplicity I have shown it as one unit. Normally one of the echelons (a) or (b) of the field bases will be assembled at a central refilling point, which in the diagram may be considered to be at E.

It must, as I have already said, be static, in fact, on its stability will to a considerable extent depend the smooth working of the administrative services which is so essential to the tactical mobility of the field army.

If it is a coastal base, its utility obviously depends on the security of the sea communications connecting it with the home base; if an industrial area, then on protection of certain land communications. These being safeguarded, the problem becomes one of protection against land and air attack. As long as the field army remains undefeated, a heavy attack upon it is a most unlikely contingency, but it must be protected against armoured cars and possibly tank raids. It should be surrounded, therefore, by an anti-tank moat and protected by mine-fields. It should also possess a small mobile column, which can make sorties against any raider.

Its security against air attack is its main protective problem. It must be equipped with the most scientifically organised ground defences, however static and delicate may be their nature, and it must possess one or more aerodromes, a series of out-lying landing grounds, and a strong force of aircraft.

Once its protection is guaranteed, the next problem is the safe replenishment of the advanced bases. Though these organisations are mobile and can move across country, it must not be supposed that railways and roads will not be used. They will be used to their full extent, and their vital points—bridges, junctions, tunnels, etc.—will have to be protected. But to supplement them, cross-country supply columns must be provided, and these I consider should be moved by powerful tractors hauling from 25 to 100 tons across country in tracked supply vehicles. These columns must be convoyed by tanks of the destroyer class.

The advanced base, as I have already stated, must be mobile; it must be able to shift its position; for though, when possible, it will occupy a road or rail centre, it will not always be able to do so, since in area warfare it may at any moment be attacked from any direction. In order that its mobility may be of a high order, its supplies and its workshops, etc., must be able to move at short notice. This means that the minimum of dumping will take place, the bulk of the supplies and workshops must, therefore, be kept on tracks.

Its protection must be more mobile than the main base. Though trenches may be dug and mine-fields laid, its chief land defence must depend on power to hit out hard, as well as to guard. Its air defence must be equally mobile, consequently, it must possess its own force of aeroplanes, and as its gun defence cannot be so delicate and complex as that of the coastal base, I consider that a self-propelled gun equipped with special sights will be the most suitable weapon.

The supplies it receives from the main base will be kept on tracks, and when required by the field army will be sent to it either by road or across country.

I now come to E, the field base, which receives supplies from F, and distributes them to the formations. It is an integral part of the field army which largely protects it—its local protection must be provided by itself.

When the whole army is assembled and is in close contact, the supply of its parts should provide no great difficulty, nor should the difficulty be great once the enemy is defeated, for defeat precludes tactical operations other than rearguard and flankguard raids. The main difficulties of supply will, I think, occur before contact is gained, and whilst the army is manœuvring for a clinch. When the wings B and B¹ are searching for the enemy, or when at a distance from A and C they are attempting to hold him, or restrict his power of manœuvre, the endurance of their pressure and resistance will depend on their maintenance. How long they can live on their own fat will depend on the size of their integral supply units. If a high mobility is to be maintained, these must be small, and the smaller they are the more frequently must they be replenished. This replenishment should, I consider, be done not by comparatively slow-moving cross-country trains as suggested for the supply of F and E, but by more rapidly moving cross-country lorries; these again will have to be escorted.

To summarise what I have now written. The whole supply organisation springs from the static main base G. From G to F, the advanced base, road, rail and cross-country trains will be used, and from F to E cross-country trains will be mainly depended on. From E to the formations themselves cross-country lorries will be the transport employed. All columns will normally have to be convoyed by fighting machines, and the types which suggest themselves as most suitable for this purpose are the scout and destroyer classes.

9. *The Organisation of the Heavy Divisions.*

The trunk A must possess great resisting power so as to enable the wings B and B[1] to maintain their mobility. As normally great battles take place in moderately open country, this trunk in the main must be a mechanical force; but as it may at times be called upon to fight in infantry areas, it must also include infantry. I will suppose that it is composed of heavy divisions, each of two brigades.

A heavy brigade must be able to carry out its own reconnaissance, therefore I will allot to it a battalion of scout tanks, or a battalion of armoured cars.[1] For its resisting power I will allot to it one battalion of assault machines. These are its capital ships, and as they are never likely to exist in great numbers, they should be protected by two battalions of destroyer tanks. To increase the resisting power of this force I will allot to the division two brigades of self-propelled guns. Such I consider will be its main mechanical arms.

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[1] I am of opinion that eventually the present armoured car will be replaced by a tracked, semi-tracked, or multiple-wheel machine.

To assist it in reconnaissance, and to protect it from air attack, the division will require at least two squadrons of aeroplanes. Further, if cavalry can be so equipped that they can average fifty miles a day for three or four days on end, they will still prove not only useful for local reconnaissance, but most valuable for purposes of communication, traffic control, and police work.

As the infantry will be required to move with the heavy divisions they must be carried in cross-country machines. In open country they are useless, and in mountainous country the tanks are almost equally so; but if a new type of soldier, namely, a tank-infantryman[1] were to be created, then this difficulty would in part be overcome. What I suggest is that every tank (and armoured car) soldier should not only be trained as a tank driver and gunner, but also as a light infantryman. If, for example, a tank battalion consists of 40 tanks, and each machine requires a crew of five men, then I suggest that each machine be allotted four crews. One of these crews would be in the machine, and three in cross-country vehicles. All the men would be trained to fight in a tank, or to fight as light infantry. The maximum fighting power would, therefore, be 40 tanks and 600 light infantry, or, if the tanks cannot be used, then about 700 light infantry, as about 100 would be required as "tank-holders." Not only would this organisation enable both types of ground to be fought over by the same soldier, but would provide the tanks with three reserve crews apiece, a most important reserve, since in war, though it should not be difficult to replace machines, it will always be difficult to train a reserve of tank drivers and gunners.

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[1] This was done in our own army during the war, for all tank crews were trained to fight as Lewis gunners in the open.

The strength of a heavy brigade may very roughly be calculated as follows:

Units.	Number of Machines.	Strength of each crew.	Strength of crews.	Strength of spare crews.	Unit Administrative personnel.	Cross-country vehicles.	Supply vehicles.
1 Bn. Scout Ts.	40	3	120	600	180	52	15
1 Bn. Assault Ts.	40	7	280	560	210	52	20
2 Bns. Destroyer Ts.	80	5	400	1200	400	108	30
	160	—	800	2360	790	212	65

The totals for the tank-infantry portion are therefore 160 tanks, 277 cross-country vehicles, and 3,950 officers and men, or 7,900 for the division. Adding 1,100 officers and men for the two brigades of artillery, the cavalry regiment and the two squadrons of aeroplanes we get a total of 9,000, which probably will rise to about 10,000 when sappers, signallers and special troops for the local protection of the divisional field base are added. Add to this forty per cent. for administrative services and convoy troops, and the total personnel strength of a heavy division will be about 14,000 officers and men.

The heavy division as we see is divided into two categories of troops, those who can fight in tank areas, and those who can fight in infantry areas. Whichever area is met with the troops not required to fight in it will be relegated to the field base E, and when both areas are simultaneously met with this base will not only protect itself, but will be protected by force C until this force is required to carry out the decisive attack on the enemy's flanks or rear.

10. *The Organisation of the Light Divisions.*

I will now turn from the composition of the heavy division to that of the light division, one or more of which should form the tactical arms, or wings of the central trunk. Its mobility should be considerably higher than that of the heavy divisions, and this mobility should be gained, not so much by building faster machines, but by so organising this formation that it possesses little impedimenta. To gain this mobility the organisation of the light division must be entirely mechanical. Cavalry can form no part of this organisation during the highly mobile phases of a war, and if, when the slower phases set in, it is considered that cavalry will prove useful, then

I am of opinion that they should be held in reserve at D or F until these phases develop.

Without infantry these wings will not be able to operate freely through infantry areas. This limitation must be accepted, for to encumber this formation with a large number of cross-country vehicles would detract from its mobility. If these areas are met with and are occupied by the enemy, then the light divisions must either hold the enemy until the heavy division can approach, or else, through their high mobility, they must circumvent these areas and cut their garrisons off from their base.

Each light division I suggest should consist of two brigades, each consisting of:

Units.	Number of Machines.	Strength of each crew.	Strength of crews.	Strength of spare crews.	Unit Administrative personnel.	Cross-country vehicles.	Supply vehicles.
1 Bn. Scout Ts.	40	3	120	120	60	12	10
3 Bns. Destroyer Ts.	120	5	600	600	300	60	45
	160	—	720	720	360	72	55

This gives a total of 160 tanks, 127 cross-country vehicles, and 1,800 officers and men. For the combatant part of the light division this number must be doubled—3,600—and brought up to 4,000 to include sappers and signallers. Adding to this forty per cent. for administrative services we obtain the grand total of 5,600 officers and men for each light division.

The spare crews should not, so I consider, be trained to fight as light infantry, but in place to protect the administrative units against tank and infantry attack.

11. *The Organisation of the Pursuit Divisions.*

The force destined to deliver the knock-out blow should consist of one or more pursuit divisions, each consisting of two brigades, each of three battalions of pursuit machines. No other machines should be allotted to these brigades, otherwise mobility will suffer, therefore, the reconnaissance requirements of a pursuit brigade should be carried out by aircraft. The establishment of a pursuit battalion might be as follows:

Units.	Number of Machines.	Strength of each crew.	Strength of crews.	Strength of spare crews.	Unit Administrative personnel.	Cross-country vehicles.	Supply vehicles.
1 Bn. Pursuit Ts.	40	7	280	280	140	28	20

For each brigade this would make 120 tanks, 144 cross-country vehicles, and 2,100 officers and men, or for a pursuit division, 4,200 officers and men, or with sappers and signallers about 5,000.

When in action, it is important that the six pursuit battalions of these divisions should be entirely freed from the responsibility of protecting their administrative services, yet it is equally important that these should be protected. I suggest, therefore, that each pursuit division be allotted one destroyer battalion for this purpose, strength in personnel 500, and a chemical warfare and bridging battalion, which will bring the combatant strength of the division up to 6,000. Add to this forty per cent. for administrative personnel, and the total strength will be 8,400.

12. *The Organisation of the Army of Occupation.*

Thus far I have only considered that part of an army which can destroy the enemy's strength, and break down military opposition. But victory in itself is only a means towards an end, the end being political action. To guarantee that this action may become effective, it is not only necessary to destroy the enemy's military strength, but to occupy his country, and establish a condition of tranquillity which will enable political action to take effect. In recent times this occupation has been carried out by the fighting troops themselves, since numbers of men were required for this purpose, and infantry were as cheap as a special police force. When armies become mechanised, this condition will change. First, mechanical armies will be comparatively small, secondly, they will not be well suited for this work, and thirdly, it will be extravagant to use them for it. I am of opinion, therefore, that in wars which demand occupation, as most wars do, for occupation of an area to a large degree guarantees its security as a tactical base of operations, the mechanical forces will have to be followed by a police force. This force I am of opinion will be largely composed of the arms we know to-day, namely, cavalry, artillery and infantry. Certain modifications will undoubtedly be introduced, such as 'bus columns and anti-tank units; but changes are unlikely to be radical since occupation and police work demand not so much the coercion of the enemy's civil population as their control. This control can best be gained by freely moving amongst them.

This army of occupation may also be called upon to carry out another duty, namely, the reinforcement of the infantry of the mechanical army should extensive mountain warfare or forest-fighting become necessary.

13. *The Ideal Army in* 1946.

Though it is impossible to foresee in detail what an army will look like twenty years hence, it is possible, as I have attempted to do, to consider the defects of existing army organisation; to examine existing tendencies, and by projecting these into the future to build up a hypothetical model. If this model is based on sound principles, the probabilities are that though the armies of

1946 will, in detail, largely differ from the ideal, in principle the differences will not be radical,[1] We must remember that unless we have clearly in our heads an idea of what we want, not only must progress be extremely slow, but its cost extravagantly high. Before painting a picture an artist must have in his head an idea of what he wants to paint. He converts this idea into a sketch, and eventually elaborates this sketch into a picture. If we are to work on rational lines our procedure must be identical.

I have now outlined a sketch, rough though it be. I have started by proving, at least I hope I have, that to-day we are confronted by a new military conception, namely, area warfare, consequently, existing tactics must be changed to fit it, and consequently, military organisation must be changed in order to express these tactics.

In war, the essential is to defeat the enemy with the least possible all round loss. In peace time the essential is efficiency. Sometimes efficiency has demanded a small army, sometimes a large. In the cavalry cycle of war (400-1400 A.D.) armies were frequently microscopic in size, because no nation could recruit or pay for thousands of armoured cavalry. During the infantry cycle (1450-to-day) armies grew and grew in size until numbers swamped efficiency, and in the last war, we see a return to the horde armies of ancient Assyria and Persia.

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[1] Assuming always that they are willing to change.

To-day, in the artillery cycle, we are going, so I believe, to return to efficiency and to comparatively small armies, and for very similar economic reasons as those which governed the cavalry cycle. Directly we can free our minds from the spell of numerical superiority, that God marches with the big battalions, shall we realize this. The army of the future will follow in the footsteps of the navy of to-day. Once a maritime nation could build scores and hundreds of galleys; to-day many seafaring powers cannot afford half a dozen capital ships; even in the Great War we only possessed between twenty and thirty.[1]

My conception of the ideal army of 1946 is as follows:

(i) Two heavy divisions, strength approximately 28,000 officers and men.
(ii) Two light divisions, strength approximately 12,000 officers and men.
(iii) Two pursuit divisions, strength approximately 17,000 officers and men.

In round numbers the strength of such an army will be 2,000 fighting machines[2] and 60,000 all ranks. A microscopic force when compared to the horde armies of 1914-1918. Yet, though during the last year of the war we used up as many tanks as the number I have just quoted, can it be doubted that if the *organised* force of my sketch had existed, we could not have decimated these hordes as surely as Alexander decimated the Persians at Issus and at Arbela?

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[1] Galley fighting was sea "infantry" warfare; capital ship fighting is sea "artillery" warfare. To-day the same process of change is at work in armies as formerly was the case in navies.

[2] The cost of such a force may perplex some readers. It is not, however, prohibitive. If *on an average* each machine costs £10,000 (a high figure), the capital cost will be £20,000,000; and if the life of a machine is reckoned at ten years, the yearly replacement cost will be £2,000,000. In 1918 each day of the war was costing us from £6,000,000 to £7,000,000.

Finally, in my opinion, the artillery, or mechanical, cycle of war will reintroduce the highly professional army and conscription will be relegated to the troops of the second line, the militia which will occupy the enemy's country after his mechanised forces have been defeated, driven back, or destroyed.